Gas Journal

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Editorial Notes

Gas Sales Up

We are now coming to the end of a year which it is confidently anticipated will prove a very good one from the point of view of the Gas Industry, for business in most directions has been "looking up," and the trend is still favourable. In due course, figures of working and financial results relating to individual concerns will be divulged—first of all in the gas company accounts for the twelve months to Dec. 31, and later on in the statements for the year ending March of the local authorities owning gas undertakings.

While awaiting this information, however, we may derive a substantial measure of satisfaction from a perusal of the Board of Trade Return relating to all authorized gas undertakings in Great Britain for the year 1935, Part I. of which, dealing with the manufacture and supply of gas, was issued a few days ago by H.M. Stationery Office, Adastral House, Kingsway, London, W.C. 2, and Branches, at the price of 4s. 6d. net, postage extra. The amount charged for the Return is exceedingly modest, when compared with the amount of labour that must be entailed in its compilation, and if by some reasonable addition to the price the publication of the statistics could in any way be expedited we feel sure that such extra amount would be willingly paid by those interested in the Gas Industry, who must represent practically 100% of the purchasers. It has been with regret that we have noted a tendency in more recent years for the issue of this Return to become increasingly delayed, a fact which must tend to diminish interest as rendering the contents less topical, even though the value of the statistics as a record of the progress of the Gas Industry may remain unimpaired.

We have said that a substantial amount of satisfaction is to be derived from a perusal of this Return, the reason for this being that records in practically every branch of the Industry were achieved during the year 1935. Taking first of all the gas sales, as being the point upon which both gas maker and distribution man are likely to desire information, it is seen that in 1935 this figure increased by 5,193 million cu.ft. over the quantity sold in 1934. In bulk this is a very large amount—fully equal to the gas sold by a really big undertaking in the course of a twelvemonth. But so vast is the yearly output of gas in Great Britain that, substantial as this increase is, expressed as a percentage it looks quite modest. Actually, the quantity of gas sold in 1935 was 295,857 million cu.ft.—a peak figure, showing an increase of 1·8% over 1934. This tops the previous best year—1929—by about 3,000 million cu.ft., and we feel certain of going still better this year. It will be remembered that 1929 was the last of a series of good trade years, and that it was followed by a trough of deep depression, from which the figures show that we were only beginning to emerge in 1934. The total sales of gas in 1929 amounted to 292,598 cu.ft., but by 1933 this had been reduced to 286,144 millions. Then the upward curve to which the Industry had been accustomed before the slump in trade was resumed, by an increase in sales to 290,664 million cu.ft., which compares with the figure for 1935 of 295,857 millions. Reduced to percentages, the increased sales for the two years have been 1·6% for 1934 and, as already mentioned, 1·8% for 1935.

Further Statistics

The present Board of Trade Return includes 718 authorized gas undertakings, which indicates merely a continuation of the drop in numbers which has been a feature of the statistics for the past eight or nine years, and, but for one single break, for a good many years before that. In 1920 the number of authorized undertakings included in the Return was 798, a figure which, in the fifteen years that have since elapsed, has been reduced by no less than 80. During the latter part of this period amalgamation and absorption have been an increasingly active policy, a reduction of more than 60 authorized undertakings having taken place in the eight years from 1928 to 1935. But for the appearance in the Return of a few newcomers, the falling-off would have been even greater. On the present occasion there are included 405 company and 243 local authority

undertakings in England and Wales, and 4 company and 66 local authority undertakings in Scotland.

The increase in the quantity of gas made during 1935 (including gas bought from coke ovens) is fairly closely in line with the increased sales, at 5,796 million cu.ft. The total number of therms sold by all the authorized undertakings in 1935 was 1,404,900,589, which figure includes an estimate for those undertakings not authorized to charge on a thermal basis. The number of therms sold in 1934, calculated similarly, was 1,382,728,861. The makes of coal gas and water gas are, of course, affected to some extent by the fact that in the year under review a good deal more gas was bought from owners of coke ovens. An increase of 3,387 million cu.ft., or 1·3%, occurred in the quantity of coal gas made, but the quantity of water gas made decreased by 256 million cu.ft., or 0·8%. These figures point to increases in other directions, and as a matter of fact the coal carbonized was 157,000 tons more than in the previous twelve months; while the quantities of coke and oil used in the manufacture of water gas were more than those employed in 1934 by 20,000 tons and 1,383,000 gallons respectively. The quantity of coke and breeze made in 1935 increased by 145,000 tons, and the amount of tar made by 3,808,000 gallons. At the same time, 5,561 tons more sulphate of ammonia was produced. The makes during 1935 were: Coke and breeze, 11,500,000 tons; tar, 219,000,000 gallons; and sulphate of ammonia, 76,000 tons. The quantities of materials actually used in the manufacture of gas were: Coal, 17,294,000 tons; coke for water gas and producer gas, 640,000 tons; and oil for carburetting, 41,679,000 gallons. The gas production figures, in round numbers, are: From the carbonization of coal, 260,505 million cu.ft.; water gas made in separate generators, 32,354 millions; total made (including coke oven gas), 319,342 million cu.ft. During 1935, there were upwards of a dozen alterations in declared calorific values, but whereas in the previous year the few changes that were made were all in an upward direction, on the present occasion nearly one-half of the number are from the popular 500 B.Th.U. to a slightly lower standard.

We have referred to the increasing use of coke oven gas, which has been a feature of the Return during recent years. The quantity of gas bought from owners of coke ovens during 1935, and distributed by statutory gas undertakings, was 20,455 million cu.ft., or 12·4%, more than in 1934. This coke oven gas was purchased by forty gas undertakings. Of these, the largest quantities were taken by the Sheffield Gas Company 7,098 million cu.ft.; the Newcastle-upon-Tyne and Gateshead Gas Company, 2,799 millions; the Derby Gas Light and Coke Company, 1,311 millions; and the Middlesbrough Corporation, 1,224 millions. In 1934 only 33 undertakings purchased coke oven gas.

How Gas is Used

Turning now to examine the manner in which the huge quantities of gas involved were utilized, the most striking feature is that the number of consumers continues to mount as the years roll by. In 1920, the total was 7,448,332—a figure which, by the close of 1935, had grown to 10,516,759. This last-named figure is 239,749, or 2·3%, more than that for 1934. This increase of 2·3% in the number of consumers has to be placed side by side with an increase of only 1·8% in the total quantity of gas sold, in spite of the fact that this total includes a substantially larger amount than in the previous year of gas supplied separately for industrial purposes only. In 1934 six undertakings supplied 5,543 million cu.ft. of gas for industrial purposes only through a separate main, in pursuance of the provisions of a Special Act or Order; in 1935, five undertakings similarly supplied 6,445 million cu.ft. The great bulk of this latter amount was furnished by the South Staffordshire Mond Gas Company (5,252 million cu.ft.); the four other undertakings and the quantities supplied being: Rotherham Corporation, 379 millions; Sheffield Gas Company, 221 millions; Swinton and Mexborough Gas Board, 563 millions; and Wombwell Urban District Council, 28 millions.

In addition to these separate industrial supplies, better business conditions must have resulted in larger demands for gas for the purposes of trade and industry in general, so that one is brought face to face with a falling, rather than a rising, consumption per consumer for domestic purposes. This is an aspect which should always be kept in mind. For, welcome as is the ever-growing number of consumers, especially from the point of view of stability, it is obvious that a steady growth in the domestic consumption per consumer would prove still more profitable—more particularly in these days of high district costs. It has to be admitted that, while the total number of consumers in 1935 increased by 239,749, the number of prepayment consumers was up by no fewer than 246,363, so that the increase was to some small extent at the cost of the number of ordinary consumers. Probably, the daily increasing number of flats, and the like, available, and occupied, has a good deal to do with the undoubtedly growing popularity of prepayment supplies. Still, whatever the circumstances, and whichever the class of consumer, this increased consumption per consumer must be sought in the highways and in the byways, by the adoption of attractive methods of charge which will further the introduction of additional utilizing appliances per gas installation. We know that any contraction in consumption is largely attributable to the superior economy of modern appliances, but this increased efficiency, in its turn, coupled with attractive rates for gas, should favourably influence the introduction of appliances for additional purposes. What would not that " one more appliance per domestic consumer " mean to the Gas Industry? It would certainly represent something that is well worth striving for by every means at our command. Let it therefore ever be kept in mind, and furthered as opportunity offers.

One particularly gratifying feature of the Return is a record figure for sales of gas to local authorities for street lighting purposes. As a matter of fact, the amount of gas sold for public lighting has, with one exception, shown a yearly increase since 1920, and has practically doubled since that year. The figure for 1920 was under 7,000 million cu.ft., while the consumption of gas for this purpose in 1935 was over 13,000 million cu.ft. The improved lighting conditions which this growth indicates must be good for the pedestrian, good for the motorist, and good for the Gas Industry. And, as we have said before, there can hardly be better propaganda for the Industry than the best public lighting by gas. Just one more figure may be quoted as showing that the Gas Industry never stands still. In ten years 16,000 miles of additional gas mains have been laid, raising the total to 59,000 miles.

The Gum Problem

In a general comment on the Autumn Research Meeting of The Institution of Gas Engineers we characterized the Paper which Mr. H. Hollings presented on the formation of nitrogenous gum during storage and distribution of gas as a triumph of organized scientific research, carried out as a team over a number of years. The investigation was actually commenced in 1932, and the conclusions of a vast amount of work are strikingly clear and simple. We regard the Paper, from the point of view of the value of the material put forward and its method of presentation, as a model of its kind. Of course, an investigation such as this could only have been instituted, and brought to such a successful conclusion, by an undertaking possessing very great technical resources. Even so, the method of attacking a baffling problem, and the manner in which the work has been directed and co-ordinated, are quite remarkable and reflect credit on the Gas Industry. There can be little fear for the future if this is indicative—and we think it is indicative—of the new outlook of the Industry on the value of applied research.

It will, we suggest, serve a useful purpose if we reiterate here some of the main findings of the Paper, which provides a reasonable explanation of an apparently unreasonable state of affairs. In the first place, it is clear that gum deposits are due to interaction between small quantities of nitric oxide, oxygen, and certain unsaturated hydrocarbons. Though coal itself yields some nitric oxide, most of the nitric oxide in coal gas is due to waste combustion gases drawn into the retorts from the heating flues, or to air drawn in at the retort mouthpieces which burns inside the retorts. The importance of pressure governing in the retorts and the maintenance of tight retorts and retort fittings has previously been emphasized from the point of view of gas leakage. The in-leakage of either waste gas or air to the retorts is equally undesirable in relation to the maintenance of a low nitric oxide concentration in the gas.

Very little nitric oxide is abstracted in the ammonia recovery plant, but the iron oxide purifiers normally absorb about 50% of it. The gas leaving the oxide purifiers contains nitric oxide, but no gum. Our readers will be aware of the process for nitric oxide removal developed in America by Fulweiler and his collaborators, in which an extra pair of purifiers charged with ferrous sulphide on shavings is employed. In a test of the investigation described in the Paper, one box of a purification system was charged with a mixture of 35 tons of soda ash and 120 tons of oxide. For two months working after the oxide in the special box had become sulphided, the average extraction of nitric oxide was 96%, and at the end of this period the specially charged box was functioning perfectly. It is essential, however, in this process that the gas should be free from tar and have a very low oxygen content. Again, after the efficiency of the special material for nitric oxide removal has fallen off, it must not be revivified by aeration and returned to the system for further absorption of hydrogen sulphide or nitric oxide. Should it be decided to combine nitric oxide removal with hydrogen sulphide removal, by utilizing the hydrogen sulphide in the gas for the production of ferrous sulphide, then the advancement of the oxide countercurrent to the gas must be adopted. Revivification of sulphided oxide, either *in situ* or externally, must be strictly avoided, and the sulphur content of the spent oxide is thereby very much reduced. When the stringency of hydrogen sulphide removal is high and when revivification and backward rotation contribute so much to the economy and efficiency of purification, it is doubtful whether restrictions in the operation of oxide purifiers to promote further removal of nitric oxide can be justified.

Therefore, the conclusion is drawn, until such time as there is an economic method of removing nitric oxide from the gas, the holders must be regarded as having two functions in addition to that of storage. They must be regarded as reaction chambers in which the small quantities of nitric oxide in the gas react with unsaturated hydrocarbons and oxygen to form gum, and as chambers in which the gum so formed settles from the gas. Time must be allowed for such settlement to take place; and it has been found that gum particles settle at a greatly increased rate if the gas is in such a state that moisture is condensing. The Paper states that it may be necessary to add live steam at the holder inlet in hot weather in order to promote saturation and subsequent condensation. For these reasons gas drying plant should be installed at the outlet of gasholders. Originally, of course, gas drying plants were usually installed at the holder inlet because of the more uniform flow of gas there, and also to minimize pressure loss between the holder and the consumer. Recent improvements in gas washing appliances, however, have provided types of plant which will operate economically with wide variations in gas load and with very small loss of pressure. Adequate storage of gas in holders having the inlet and outlet pipes far removed is advantageous. Distribution of a mixture of stored and unstored gas is particularly objectionable.

The effect of benzole recovery is discussed in the Paper. The rate of the gum formation reaction is primarily dependent on the concentration of diolefines in the gas; and in most coal gases and in carburetted water gas the concentration of diolefines is sufficient to cause rapid reaction. When gas is stripped by active carbon the diolefines may be removed to such an extent that reaction in the resulting gas is either extremely sluggish or entirely suspended. In such cases the admixture of unstripped carburetted water gas is desirable. The normal type of oil washing process for benzole usually leaves sufficient diolefines in the stripped gas for subsequent reaction to proceed normally.

To the engineer, reversion to the storage of a gas saturated with water vapour cannot in itself appear as other than a retrograde step; but no step can be regarded as retrograde which results in greater satisfaction to the consumer, and the recommendations set out in the Paper to eliminate gum troubles have certainly the great merit of simplicity.

Domestic Coke

Last week a joint meeting of the North-Western Section of the Institute of Fuel and the Manchester District Association of Gas Engineers was held in Manchester, and the subject for discussion was the production and utilization of domestic coke. The symposium was introduced by Mr. Arnold Marsh, General Secretary of the National Smoke Abatement Society, and there were seven short Papers, two of which—those by Prof. J. W. Cobb and Mr. H. J. Hodsman and by Mr. E. W. L. Nicol, of the London and Counties Coke Association—are published in our issue of to-day. We shall deal

later with the other contributions. It may be said at once that all the contributions are of more than ordinary interest.

In his introduction, Mr. Marsh suggested, and we are with him in this, that for a long time to come the open fire will be demanded and will have to be included in the great majority of new houses. For effective smoke abatement, therefore, smokeless open grate fuels must be made more popular, and the line of attack must be twofold. While "ordinary" gas coke is a highly satisfactory fuel for use in special grates fitted with gas ignition, there will still be a demand for free-burning and easily ignited cokes which burn satisfactorily in any appliance which burns bituminous coal. A co-ordinated gas-coke development seems indicated, and "proposals that have been made for price concessions to consumers who take the coke from which their gas is made, and *vice versa*, appears, to one outside the Gas Industry, to be a promising means for development." This idea of linking up coke sales and gas sales is well worthy of consideration. In this connection some little time ago Mr. A. L. Jennings, of Spenborough, made an interesting suggestion. His argument was that a consumer who uses 30,000 cu.ft. of gas has caused approximately 2 tons of coal to be used for its production, resulting in the availability of about 1 ton of coke for sale. If the consumer buys this ton of coke at yard price, his gas has been produced possibly 2d. or 3d. per cu.ft. cheaper than that for another consumer who leaves the coke as a surplus. The use was suggested of a coupon attached to tickets for coke sold for domestic consumption, entitling the consumer to a reduction in the price of gas in the ratio of 2 cwt. of coke to 3,000 cu.ft. of gas. Whatever the ratio, however, the idea of rewarding the consumer who takes both gas and coke holds out much promise. Mr. Nicol mentions that the seasonal coke consumption of each gas-ignited open coke grate—and the yearly sale in the area of the London and Counties Coke Association alone is of the order of 100,000—is about 2 tons, and the average yearly consumption of the domestic hot-water boiler about 3 tons. No fewer than 155,000 coke-fired domestic boilers were installed during 1935 within the area of the Association.

The subject of ash is touched upon by Mr. Hodsman, who puts forward the view that the quantity and kind of ash may weigh more with some consumers than efficiency or price; and he regards it as surprising that so little attention has been given to this. A light ash which clings to the surface of the fuel obstructs radiation, and as it accumulates it chokes the fire and lowers the rate of combustion. Thus it may impair both thermal efficiency and output, while its tendency to drift about the room is objectionable. Some attempt should be made to give the ash content of a fuel on the volume rather than the weight basis. In any event, fuels should not be judged solely by chemical tests on small samples. If a single test is to be employed, it should be one of performance in the grate.

Beating Records

Reviewing the work of the Gas Light and Coke Company in 1935 at the annual meeting of the Company in February last, Sir David Milne-Watson referred to the unprecedented rate at which new and more economical gas appliances were displacing older models. During last year the number of new appliances supplied by the Company was well over 600,000; in other words, they were installed at the rate of more than one a minute throughout the whole of the year. Sales of appliances continue to expand, as was explained by Sir David at an extraordinary general meeting of the Company held on Nov. 13, an account of which was published in the "Journal" last week. Records are being broken, and the purpose of the meeting was to sanction the raising of a further £3,000,000 share capital and £1,875,000 loan capital, which resolutions were carried.

The figures which Sir David gave at the meeting are exceedingly encouraging, and show what can be accomplished by a live sales and service organization backed by first-rate advertising. He mentioned that in June, 1934, the total sum outstanding on hire-purchase contracts amounted to £645,000, but in June last it had increased to £2,688,000—over four times as much. The total sales during the nine months ended last September amounted to £1,630,000, while the policy of exchanging old-fashioned cookers for modern enamelled cookers is giving the liveliest satisfaction to prepayment consumers. Since the beginning of the year the number of stoves exchanged has been 144,000. All this new equipment means satisfied consumers, and its installation is the best way of meeting competition. "Gas consumption," said Sir David, "is increasing very satisfactorily." This increase is, of course, the result of applying modern methods to the selling of modern heat service. As we have said, Sir David's story is a heartening one.

The Shewring Fund

In another part of this issue will be found a letter to the Editor in which Mr. F. G. Shaw announces the decision of the promoters to close the Shewring Fund immediately after Christmas. The whole Industry, we know, will have derived satisfaction from noting the total subscriptions recorded from time to time in our columns, because the matter is one in which all must have felt some sense of responsibility. The varied sources from which donations have been received have been a clear indication of the very general sympathy with which the appeal has been received, and contractors, gas undertakings, and individuals have all played their part.

In such a splendid response it is invidious to refer to individual efforts, but we may perhaps remind readers of the letter, published on Sept. 16, from Mr. Cecil H. Bamber, who had succeeded Harold Shewring at Rochdale, and had been asked to forward to the Fund a donation collected from the Rochdale Gas Committee, Gas Engineer, Staff, and Workmen; the Mayor, Aldermen, Councillors, and Chief Officials of the Rochdale Corporation, and other friends at Rochdale. We mention this particular contribution as evidence of the esteem in which Harold Shewring had been held by those among whom he had worked, and we couple it with Mr. Shaw's final appeal in this issue in the hope that intending contributors will delay no longer. There are roughly four weeks left; those who send in their donations at once will be certain of not forgetting.

Personal

We learn that Mr. FRANCIS GOODALL SYMON has been appointed Assistant Engineer and Manager to the Stretford and District Gas Board.

For the past three years Mr. Symon has been Assistant Engineer and Manager to the Coatbridge Gas Company. Prior to going to Coatbridge he gained experience with Messrs. Henry Balfour & Co., Ltd., Leven, the Wemyss Coal Company, Ltd., the Motherwell and Wishaw Gas Department, and the Glasgow Corporation Gas Department.

He is an Associate Member of The Institution of Gas Engineers, and at the Autumn Research Meeting this year he was presented with a First-Class Diploma in Gas Engineering.

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We learn that Councillor J. DUNCAN has been elected Convener of the Edinburgh Gas Committee for the ensuing term.

Obituary

The death occurred suddenly on Nov. 17 at his residence, Kirkford, Stewarton, Ayrshire, of Mr. WALTER WILSON, Engineer and Manager of the Stewarton Gas Light Company for over 15 years.

* * *

The death occurred at Shrewsbury last week of Mr. JOHN CHARLES BELTON, formerly Engineer and Manager to the Chester United Gas Company.

Mr. Belton, who was 78 years of age, was a native of Longdon, near Wellington, and succeeded his father as Manager of the Wellington (Salop) Gas Company. Later he held appointments as Engineer with the Willenhall (Staffs.) Gas Company and the Redhill (Surrey) Gas Company before going to Chester in 1899. He retired from his Chester appointment about 20 years ago and went to reside at Shrewsbury some eighteen months ago, after the death of his wife.

One of his sons, Mr. C. M. D. Belton, who is the present Engineer, Manager, and Secretary of the Shrewsbury Gas Light Company, succeeded his father's brother, the late Mr. W. Belton, to that position some years ago. Another brother, Mr. F. W. J. Belton, is Engineer to the Christchurch Gas, Coal, and Coke Company, New Zealand.

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Our attention has been drawn to two omissions from the list of floral tributes to the late J. C. Walker which we recorded last week in connection with his burial. One was from Messrs. Glover & Main, Ltd., and the other from the "Scottish Gas Organizations." Mr. J. W. Napier points out that special arrangements were made for the sending of the latter at the request of Mr. T. Maule Guthrie, Brechin, Chairman of the National Gas Council (Scotland), and of Councillor Walter Muter, Edinburgh, Chairman of the Federation of Gas Employers (Scotland).

Correspondence

Effect of Alkalis on Refractories

SIR,—I have read with interest the article in your number of Nov. 11, in which Mr. H. T. S. Swallow deals with the effect of alkalis on refractories in the gas and coking industries. In it he refers at some length to my earlier work on that subject, and particularly in the light of results obtained recently in working a gas producer with additions of sodium carbonate and lime to the charge.

I would, however, like to emphasize once more that the destructive effect by "chattering," or internal bloating, was viewed by me as dependent upon:

(1) The penetration of the porous brick work by an easily volatilized compound of sodium—namely, sodium chloride;

(2) Volatilization of iron compounds, again depending upon the presence of chlorine;

(3) The temperature conditions in the brick resulting from its being in a wall heated from two sides.

(The analysis quoted by the Author as given by Mott and Hodsman of a piece of the honeycombed portion of a chattered wall was quite consistent with that view, since the proportions of alkali and ferric oxide, 2·4% and 3·95% respectively, indicated the occurrence of both the penetrating and volatilizing effects.) These three conditions were, however, all absent in the experiments as described by the Author, where the comparatively non-volatile sodium carbonate was acting on brickwork heated on one side only. The results obtained were not the same, and it would be very surprising if they were.

I was pleased, but not at all surprised, to read of the comparatively small destructive effect experienced in the use of sodium carbonate, and hope that the producer experiments in taking advantage of the enhanced reactivity of coke in the presence of such inorganic additions as soda and lime may justify completely by their results the work of Mr. Swallow and his colleagues of Imperial Chemical Industries. No doubt they have also in mind that modern developments in the design of gas producers and water-gas generators tend to eliminate the use of refractories altogether in the high temperature regions.

Yours, &c.,
JOHN W. COBB.

The University,
Leeds, 2.
Nov. 17, 1936.

The Shewring Fund

Closing Date

W. Rupert King, Esq.,
Editor, "GAS JOURNAL,"
11, Bolt Court, Fleet Street,
London, E.C. 4.

DEAR MR. KING,

I feel sure that those who have so generously subscribed to the Fund will have been extremely gratified by the total to date, as recorded in your issue last week.

Naturally, before asking your co-operation in the launching of the appeal, I had satisfied myself fully of the need for an effort by the Gas Industry on behalf of the dependants of one of its sons who had made the great sacrifice. I can assure you, however, that all additional circumstances which have come to my knowledge since then have redoubled my conviction of the call there was for making the effort, and of the wonderful service which the generosity of our many friends and helpers will have rendered.

After consultation with my collaborators, Messrs. W. W. Townsend and J. Bridge, it has been decided to close the Fund immediately after Christmas, and I take this opportunity of making one more appeal to all those who have not yet subscribed to give the matter one more moment's consideration.

I am proud to state how unanimous the subscribers have been in regarding the Fund as a tribute to an act of courage and self-sacrifice, honourable both to the man and the Gas Industry, but at such a cost to his widow and children. "The widow's mite—yet full of appreciation for such a display of gallantry" was the comment of one subscriber, which seems to me typical of the spirit in which the Industry has met our appeal.

Yours faithfully,
F. G. SHAW,
Engineer and Manager.

Buxton Corporation Gas Department,
Gas Service Buildings,
Buxton.
Nov. 23, 1936.

Gas Journal Shewring Fund

Donations are invited to the Fund, full particulars of which were given in the "JOURNAL" for July 22. The Management of the Fund is in the hands of Messrs. F. G. Shaw (Buxton), W. W. Townsend (Colchester), and J. Bridge (Elland). All expenses having been guaranteed, the whole of the sums received will be applied, without any deduction whatsoever, to the benefit of the widow and children of Harold Shewring, by whose tragic death earlier this year they were left in distressed circumstances.

Cheques should be made payable to the "GAS JOURNAL," and crossed "Shewring Fund Account." All donations will be gratefully acknowledged by the Editor, who is Treasurer to the Fund.

We are pleased to be able to announce that the total to date amounts to £777 3s. 0d.

News in Brief

A New Gasholder of 600,000 cu.ft. capacity is to be erected at Pathhead following a report by the Convener of the Gas Committee and the Gas Engineer to the Kirkcaldy Town Council.

At One of the New Pedestrian Crossings the Newcastle-upon-Tyne and Gateshead Gas Company recently offered to install experimental lamp beacons. The offer has been accepted by the Newcastle Watch Committee.

Application for a Special Order is intended to be made to the Board of Trade under Section 1 of the Gas Undertakings Act, 1929, by the Shotley Bridge and Consett District Gas Company with the object *inter alia* of raising additional capital.

A Considerable Area of Newport (Mon.) was in darkness just before 11 o'clock on Sunday evening, Nov. 22, in consequence of some fault in the electricity supply. All street lamps and private lighting in the Allt-yr-yn district were extinguished for some time.

Applications are Invited by the Corporation of Glasgow Gas Department for the position of Manager of the Chemical Works. The salary for the position, further particulars of which will be found in our advertisement columns, is £650, rising by biennial increments of £40 to £850.

A Well-Trained Works Superintendent is required by the Cheltenham and District Gas Company, who are inviting applications for the position, which carries a salary of from £400 to £500, according to experience and qualifications. Further particulars are to be found in our advertisement columns.

Application Forms returnable on Dec. 21 and particulars of the Associate-Membership Examination for 1937, together with the memorandum on "The Training of a Chemical Engineer," may be obtained from the Hon. Registrar, Institution of Chemical Engineers, 56, Victoria Street, Westminster, London, S.W. 1.

The Improved Lighting of the portion of Abbey Foregate between Bell Lane and the Column, Shrewsbury, has been the subject of much favourable comment. The improvement has been brought about by the installation of new gas lamps of the "cluster" type, with "Holophane" refractors. A marked feature is the visibility of the kerb-line, which is a great aid to safe night driving.

A Gas Supply to Portstewart is shortly to be put in hand now that the Coleraine Borough Council have approved of the specification in a scheme for extending the gas mains to that district. The scheme is estimated to cost £16,000 and will entail the laying of 6,700 yd. of high-pressure main between Coleraine and Burnside, and 10,000 yd. of distribution mains and services throughout the town of Portstewart.

The Second Lecture in connection with the winter series to the Outdoor Staff of the Sales and Distribution Departments of the Sheffield Gas Company was held on Friday night, Nov. 20, at the chief showrooms, High Street, before a large attendance of employees. This lecture was given by Mr. T. B. V. Hirst, Assistant to the Chief Engineer, Messrs. Ascot Gas Water Heaters, Ltd., 244, High Holborn, W.C. 1. Mr. Hirst gave a most interesting talk on "Hot Water" and showed, by means of slides, methods of obtaining full satisfaction from the use of instantaneous water heaters. The lecture was much appreciated by the large audience, and a splendid discussion ensued.

Women's Gas Circle

Birmingham Branch Visit John Wright's Works

At the invitation of Messrs. John Wright & Co., Ltd., some 340 members of the Birmingham Women's Gas Circle (which is now affiliated to the Women's Gas Council) have visited the Aston Works of this firm during the past few weeks.

In order to ensure that the visitors had every facility to inspect the work in progress and to understand with a maximum of convenience the information and explanations imparted by the guides, it was arranged that parties of approximately 70 should attend on various dates.

Prior to the tour of the works a member of the staff gave an explanation of the construction and working of the "Regulo," and it was particularly interesting to the visitors to hear what the "Regulo" actually is, and how it operates. It is difficult to single out the process which aroused most interest; but wonder there certainly was that, from the uninspiring appearance of the dull castings in the foundry, there finally emerged the finished products so familiar to the visitors. The opportunity of paying this visit afforded the members of the Circle an insight into the careful thought and research expended upon appliances of daily use.

At the conclusion of each visit, John Wright & Co. kindly provided tea for the party, and a hearty vote of thanks was passed by the members of the Birmingham Women's Gas Circle for the instructive and enjoyable time they had spent.

New Tariff at Smethwick

Block Rate Based on Number of Rooms

The Smethwick Gas Committee has decided to put into operation the following tariffs:

New Domestic Tariff.

—	Price Per Therm.	Equivalent Price Per 1,000 Cu.Ft.
	d.	s d
Quarterly meters—		
For all gas consumed up to the fixed quarterly consumptions in scale below (First Block) .	9·3	3 5·85
For a further similar quantity of gas consumed during the same quarter (Second Block). .	8·2	3 1
For all gas consumed during the quarter in excess of the First and Second Blocks . .	5·5	2 1
Prepayment meters*—		
For all gas consumed up to the fixed quarterly consumptions in scale below (First Block) .	10·2	3 10
For a further similar quantity of gas consumed during the same quarter (Second Block). .	9·1	3 5
For all gas consumed during the quarter in excess of First and Second Blocks . . .	6·0	2 3

* The meters are set at 15 cu.ft. per penny (price includes the hire of the meter and fittings), and on amounts collected the appropriate rate of discount will be returned to consumers at each collection provided the cash in the box agrees with the amount due according to the gas used as registered by the meter index.

Fixed Quarterly Consumptions.

—	Winter Quarters.	Summer Quarters.
	Cu.Ft.	Cu.Ft.
Four rooms or less	6,000	4,000
Five rooms	7,000	4,000
Six rooms	8,000	5,000
Seven rooms or more.	10,000	7,000

NOTE.—In the case of prepayment meter consumers, the fixed quarterly consumptions will be apportioned on a monthly basis.

Tariff for all Other Purposes—Commercial and Industrial.

Consumption per Quarter. Cu.Ft.		Pence per Therm.	Per 1,000 Cu.Ft. s. d.
000 to	7,000	9·3 equal to	3 6
7,000 ,,	15,000	8·9 ,,	3 4
15,000 ,,	50,000	8·4 ,,	3 2
50,000 ,,	100,000	8·2 ,,	3 1
100,000 ,,	500,000	7·8 ,,	2 11
500,000 ,,	1,000,000	7·6 ,,	2 10
1,000,000 ,,	2,000,000	7·3 ,,	2 9
2,000,000 ,,	3,000,000	7·1 ,,	2 8
3,000,000 ,,	4,000,000	6·9 ,,	2 7
4,000,000 ,,	5,000,000	6·7 ,,	2 6
5,000,000 ,,	6,000,000	6·0 ,,	2 3
Excess at		4·9 ,,	1 10

Subject to 5% discount for prompt payment.

Date of Commencement.

The revised scale for ordinary consumers will operate on readings of the meters after Dec. 31, 1936. The revised scale for prepayment meter consumers will operate on all collections after Oct. 31, 1936. Commercial and Industrial: Where the meters are read at the end of September quarter, the new scale will operate as from the date of such readings, and in the case of meters on "continuous meter readings" on readings from Dec. 31, 1936.

A Symposium on Coke

Gas Engineers and Institute of Fuel Meeting

A Joint Meeting of the North-Western Section of the Institute of Fuel together with the Manchester District Association of Gas Engineers was held on Nov. 18 at the Midland Hotel, Manchester, when a discussion was opened on "The Production and Utilization of Domestic Coke." Eight short Papers were presented, and formed the basis of the discussion.

Prior to the discussion taking place the members of both organizations met at luncheon, which was presided over by Mr. A. Stubbs, Chairman of the N.W. Section of the Institute of Fuel.

Sir PHILIP DAWSON (President of the Institute of Fuel), in proposing the toast of "The City and Port of Manchester," said that the Manchester Corporation had done all they could to encourage the use of smokeless fuel, realizing the vast harm that the presence of smoke in the atmosphere caused to the health of the people, as well as a serious pecuniary loss. The Institute of Fuel was, he thought, the only Institute which comprised in its membership the producer, the distributor, and the consumer of every class of fuel. It took the greatest interest in educating people in the best uses of fuel, and of training people to become the best exponents of its use in the factory or in the home. He should feel very proud if, during his term of office as President, there should be created Chairs of Fuel Technology at the universities.

The Rt. Hon. the LORD MAYOR OF MANCHESTER (Alderman J. Toole), responding to the toast, said that later in the afternoon he would be attending a meeting at the Manchester University, and would not fail to ask its governors to take the lead in suggesting the establishment of a Chair of Fuel Technology.

Mr. A. STUBBS proposed the toast of the Manchester District Association of Gas Engineers.

Mr. A. L. HOLTON, President of the Manchester District Association of Gas Engineers, proposing the toast of the Institute of Fuel, stressed the importance of mutual helpfulness in research work in regard to the utilization of all types of fuel.

Standardization—National and International

Very few industrially developed countries to-day do not possess authoritative bodies responsible for the organization and establishment of national standards within their borders. This is, perhaps, the most striking fact that emerges from a perusal of "A Survey of the Present Organization of Standardization, National and International."*

The Survey is complete and highly informative without being unwieldy; the matter in bold easily-read print fills but fifty-five pages. The work was undertaken by the World Power Conference International Executive Council, with the generous assistance of the National Committees which is gratefully acknowledged in the Preface to the Survey, with the object of promoting co-operation between experts of different nationalities. Recognition of the need for this vital co-operation led the International Executive Committee to initiate an enquiry into the present organization of national and international standardization. For a number of years, it appears, evidence had been steadily accumulating of apparent duplication or overlapping in the field of work of the various national bodies, due no doubt to the vast range of process which standardization must of necessity embrace.

Be it noted here, however, that the W.P.C. has no intention of acting as a standardizing body or of engaging in any way in standardization activities. Reverting to the preface we find: "In so far as questions of standardization affect the interest of its members, the functions of the World Power Conference are to provide a forum for the preliminary discussion of such questions, to suggest to the standardizing bodies directly concerned . . . matters which appear ripe for standardizing action, and to perform the function of a clearing house of information on standardization work already achieved for the benefit of its National Committees and their constituent members."

The Survey indicates that nineteen countries have one single recognized standardizing body. These are Australia, Austria, Canada, Czechoslovakia, Denmark, Finland, France, Germany, Great Britain, Hungary, Japan, Netherlands, New Zealand, Poland, Roumania, Sweden, Soviet Russia, Union of South Africa, and the United States. Four countries report one or more organizations having functions in the field of standardization, but not as the recognized central standardizing body. These are Belgium, Italy, Norway, and Switzerland. Five countries (Argentine Republic, Estonia, Jugoslavia, Latvia, and Spain) report standardization as being in process of organization, and four countries (Danzig, Egypt, India, and the Irish Free State) report no organized standardization or recognized body.

There is no need to dwell upon the work of our national standardizing organization, the British Standards Institution, whose organization, as well as that of other countries who have any standardizing activities to report, are described and correlated in the Survey. It is only right, however, to draw attention to the fact that the B.S.I. is notable in the sphere of co-operation which the W.C.P. so earnestly desire and, while acting more and more for the country as a whole, co-operates with all similar central standardizing bodies in other countries.

Standardizing is an immense work when considered from a national viewpoint, but in its wider international aspects the problem assumes even greater proportions. The W.C.P. Survey is, therefore, most opportune, and constitutes a vital contribution to the cause of rational standardization.

* London: Central Office, World Power Conference, 36, Kingsway, W.C. 2. Price, 3s. 6d.

Explosion at Newcastle

The Newcastle and Gateshead Gas Company disclaim any blame whatever for the explosion which occurred on Tuesday, Nov. 17, and wrecked a terrace house converted into flats in Scotswood Road, Newcastle, killing four persons and injuring seven.

In a statement to the "GAS JOURNAL," Mr. T. P. Ridley, Commercial Manager and Secretary of the Company, said: "We have made a full investigation into this matter and we are satisfied that the explosion occurred through no fault of ours. The Company were not to blame." Mr. Ridley added that he could not as yet say what caused the explosion.

The explosion occurred about nine o'clock and completely wrecked a house of two flats. The houses on either side remained intact, the wrecked house collapsing as though cut with a huge knife, burying the occupants in debris.

The dead were Mrs. Annie Walton (52), of 377, Scotswood Road; John Turner (11), of Plummer Street; John Robson (9), of Back Penn Street; and William Wallace (44), of Bentinck Street.

The Newcastle Fire Brigade and workmen of the Newcastle and Gateshead Gas Company extricated the injured from the wreckage and officials carried out investigations until the early hours of the morning.

Among those sustaining minor injuries was a workman of the North Eastern Electric Supply Company, who stated that he had been working near the house at the time of the explosion.

The Lord Mayor of Newcastle has opened a relief fund. The injured taken to the Newcastle Infirmary are making satisfactory progress.

Forthcoming Engagements

Nov.

26.—I.G.E.—Advisory Committee on Research at 2.30 p.m.

27.—SOUTHERN ASSOCIATION.—General Meeting at the May Fair Hotel, W. 1, at 2.30 p.m.

27.—I.G.E.—Liquor Effluents and Ammonia Committee at 11.15 a.m.; Joint Research Committee at 2.30 p.m.

28.—NORTH OF ENGLAND G.M.A. (AUXILIARY SECTION).—Meeting at Newcastle-upon-Tyne and Paper by J. F. Lord.

28.—WALES AND MONMOUTHSHIRE JUNIORS.—Meeting at Newport. Paper by A. H. Dyer.

28.—SCOTTISH WESTERN JUNIORS.—Visit to Alder & Mackay, Ltd., Edinburgh.

Dec.

1.—B.I.F. JOINT STANDING COMMITTEE.—Meeting at Gas Industry House, 12 noon.

2.—LONDON AND SOUTHERN JUNIORS.—Visit to London Electric Wire Company and Smiths, Ltd., Leyton.

8.—N.G.C.—Meeting of the Central Executive Board, 11 a.m.

9.—MANCHESTER AND DISTRICT JUNIORS.—Visit to J. H. Robinson & Co. (Liverpool), Ltd. Paper by F. Bell.

9.—B.C.G.A.—Midland District Conference at Stoke-on-Trent.

A Hundred Years of Gas at Dunstable

Celebrated by Opening of New Showrooms

To mark the centenary of the Dunstable Gas and Water Company—recently acquired by the Tottenham and District Gas Company—fine new showrooms and offices were opened on Nov. 17 in High Street North by the Mayor of Dunstable, while a luncheon followed in further celebration of the event.

The Exterior of the New Premises.

The foundations of the Dunstable Gas and Water Company were laid at a meeting held in February, 1836, in the Market Room of the Town Hall, when it was decided that a Company, to be entitled "The Dunstable Gas and Coke Company," be forthwith formed for the purpose of supplying the town and parish of Dunstable with inflammable air, or gas. The original capital was £2,500 in shares of £10 each. In March of the same year the first Directors' Meeting was held, when it was decided to insert advertisements in the newspapers inviting tenders for the erection of a gas-works.

In the early years following its formation the Company passed through many vicissitudes, and, with the price of gas at 14s. per 1,000 cu.ft., its growth was slow until the year 1857, when it was decided that the works were not large enough or conveniently placed to meet the expansion of business. A new site was accordingly purchased, approximately one acre in extent, on the west side of the then recently opened L. & N.W.R. Station. These new works were erected in 1871, and portions of the old works were transferred to the new site—and it is on this site that the gas-works stand to-day.

It is interesting to record that this year—one hundred years after gas was first used for street lighting in the town—the Company have converted all the public lamps to the latest types of lanterns and burners, complete with automatic lighting and extinguishing equipment.

The output of gas in 1881—the earliest year for which records are available—amounted to 12,364,000 cu.ft.; this year the estimated output is 112,000,000 cu.ft.; and it is of interest to note that in the eighteen months since the undertaking was taken over by the Tottenham Company the output has increased by 28%.

Until the opening of the new premises last week, the only "showroom" was situated at the gas-works, and it was quite inadequate for displaying gas appliances to advantage. A temporary showroom was erected last year; but this again proved inadequate. With the opening of the new premises, however, Dunstable now has one of the finest gas showrooms for a town of its size in the country, which will enable the Company to give better and quicker service, as well as to show all the latest types of gas appliances under the best possible conditions.

The New Showrooms.

The new building, which was formally opened by the Mayor of Dunstable (Councillor F. Kenworthy), has a frontage on High Street North of 47 ft. and a depth of 54 ft., together with a further three-quarters of an acre of land at the rear for future extensions of stores and depôt.

As will be seen from the accompanying photograph, the exterior is in the Georgian style, with two large windows divided up into small panes. The interior of the building consists of ground floor and first floor, with mezzanine floor on the staircase, forming a cloakroom.

The ground floor is occupied by a spacious showroom over the whole width of the frontage and extending back for 24 ft., with stores, inspectors' office, &c., behind. On the first floor are the enquiry and waiting rooms and general office, with the Resident Manager's and Chief Clerk's rooms, separated from the general office by glazed oak screens. The offices and stores are centrally heated by Potterton's "Rex" gas-fired boilers, while the showroom is warmed by gas and coke fires which can be seen in operation.

The general interior colour scheme is in two shades of yellow, with two shades of buff in the showrooms, and mouldings picked out in pale green. The showroom floor is of rubber, panelled in green and white squares, with black border and skirting. The large first floor office is available for lectures, and can be equipped with a demonstration platform.

In the showroom are arranged up-to-date settings showing the latest designs in gas and coke fires, and movable fitments show many alternative types. The counter, of Australian walnut with ebonized bands, is in a recess in the centre of the showroom directly opposite the entrance and has a fine bronze grille with gas lighted sign. To the left of the centre is the hot water display section, where water heaters are demonstrated, and this is carried out in green atlasite with chromium plated fixing strips fitted with "Staybrite" steel troughs (with black marble top) to take the water discharged from the apparatus.

To the right of the counter are two recesses with black tiled hearths. In one is shown one of the latest type gas cookers and a gas refrigerator and in the other, which is tiled in pastel green tiles, is the central heating boiler which heats the building. Two of the central fitments provided for the display of gas fires have table tops for the display of gas irons, clinical heaters, table lamps, &c., for the demonstration of which points are provided for plugging in the gas connection.

A View of the Spacious Showroom.

The main showroom is lighted by distance-controlled Sugg ventilating ceiling lamps, and the windows, hot water bay, counter, and cooker recess are floodlighted, subsidiary lighting being provided by standard lamps. The lighting of the offices is by means of Sugg ventilating lamps. The

flues for the gas fires, ventilating lamps, and hot water apparatus are all built in with Nautilus flues.

The building was erected by the Nautilus Building and Decorating Department of the Davis Gas Stove Company, Ltd., of Luton.

Guests of the Company at Luncheon.

Following the opening ceremony and an inspection of the new premises, those present, including local councillors and other prominent residents, together with Senior Officers of the Company, repaired to the Parish Hall, Church Street, where they were guests of the Directors at luncheon—Mr. HENRY WOODALL (Chairman of the Company) presiding.

The Loyal Toast having been duly honoured, that of "The Borough of Dunstable" was proposed by Mr. A. E. BROADBERRY (a Director), who referred to his own personal associations with the town dating back to the 'eighties of the last century. He expressed the hope that the trades and industries of Dunstable would flourish and that the Company and the Council would collaborate in promoting the prosperity of the town.

HIS WORSHIP THE MAYOR, in responding to the Toast, first of all congratulated the Company upon their enterprise in building their new showrooms, which brought to their town something new in the way of architecture. He hoped that other industries would follow and help to build up the town in the way that the Company had set the example. Not only had the Company thought of the building itself, but they had also considered the welfare of their employees in the offices they had provided for them. He trusted that the Company would grow and prosper. He would be lacking in his responsibility, said the Mayor, if he did not offer a word, on behalf of the town, for the way in which the Company were lighting their streets. He regarded it as an honour to express the town's appreciation of the services the Dunstable Gas and Water Company were rendering.

The Toast of "The Dunstable Gas and Water Company" was proposed by the TOWN CLERK (Mr. J. M. Coombs), who referred to the early history of the Company and pointed to some of the difficulties with which those responsible for supplying gas in those days had to contend. The progress of the town, he said, was coincident with that of the Gas and Water Undertaking. The Company had made a wise choice in appointing Mr. R. E. Gibbons as their Local Manager when they took over the Dunstable Undertaking; he was the right man in the right place—as also was Mr. Cadman. The interests of the Company and the town were one, and the one could not get on without the other.

Mr. HENRY WOODALL, responding to the Toast, extended a hearty welcome to all those present on that occasion and thanked them for taking part in the little ceremony they had witnessed that day in connection with the Company's centenary. Those who started the Undertaking a hundred years ago were enterprising people and had given a great deal of assistance to the town in its progress. He was sorry that Mr. Andrews, who had been the Chairman of the Dunstable Company at the time it was taken over by the Tottenham Undertaking and who had rendered such great assistance in connection with the transfer, had since died. Mr. Woodall observed that he felt very proud to be the Chairman of such an ancient institution as the Dunstable Gas and Water Company, and he hoped that the people of the town would feel satisfied with the new showrooms they had built. They were indebted to the Nautilus Company who had erected the premises and also to the Architect for an admirable design; they had done their best to ensure that the building was not unworthy of their main street.

In the past the Dunstable Gas and Water Company had progressed slowly and steadily, and the Tottenham Company were surprised to find that within the short time since they took over the Undertaking—just over eighteen months—they had had an increase in output of 28%. This was a serious increase to have to deal with, and they had been somewhat hard put to it to supply the gas. They were now, however, building an entirely new gas-works, and when it was completed it would be as good as any works in the country. They had had to spend a large amount of money to meet the expansion of the Undertaking and the further growth they anticipated; and when one had to spend money in large amounts it was rather difficult to reduce the price of gas. In 1836 the price was 14s. per 1,000 cu.ft.; to-day it was 4s. 8d. This was a big reduction; and they would try to improve upon it. There was, however, another important factor—namely, that the consumer should have the best possible service. He could promise them that the Company would always supply gas of a good quality and pressure, and through their new showrooms they would also be able to make available the most modern and efficient appliances.

He was very pleased to hear what Mr. Coombs had said in regard to their staff; it was a great pleasure to know that their work was appreciated, and they were delighted to have this recognition. In conclusion, Mr. Woodall once again thanked the Mayor for opening their new premises and for their goodwill in the launching of this new venture.

The centenary of the Dunstable Gas and Water Company was further celebrated by a week of activities. Following the opening of the new showrooms, a special reception for the local branch of the Women's Gas Council was held, at which a large number of ladies were addressed by Miss K. M. Halpin (Organizing Secretary). In the evening the Company held a dinner, while throughout the remainder of the week invitations were issued to the ladies of the district to inspect the new premises. In addition, on Wednesday, Thursday, and Friday cookery demonstrations were given in the demonstration hall.

Directions for the Installation of Gas Supplies and the Fixing of Gas Appliances*

The Swiss Association of the Gas and Water Industry has performed a good service by the publication of a small volume which provides, in handy form, a succinct series of useful directions for the installation of gas supplies and the fixing of gas appliances. In their original form, the rules were issued in 1929. They were revised in the summer of 1936.

There is a right and a wrong way of doing most things. General observation of the instructions laid down in this guide will not only lead to standardization of practice throughout the Swiss Gas Industry, but will simplify the task of the gas supply engineer and fitter. A series of positive instructions does not always suffice to ensure the absence of pitfalls for the unwary, and there is thus a need for such instructions to be supplemented by some cautionary notes as to what must be avoided. These cautionary notes are provided in the form of a series of 26 carefully drawn whole-page diagrams, many of which illustrate good practice and bad practice respectively. Among them is to be found a reproduction of the badge which is attached to all appliances which have met with the official approval of the Association.

The subjects dealt with embrace services, carcassing, meters, connections, couplings and valves, flues, bafflers and terminals, the testing of installations, procedure in the event of gas escapes, and rules applicable to work executed by outside firms of gas fitters. The aim of the instructions is to provide a safe, adequate, and thoroughly serviceable supply of gas. Accordingly, such matters as type of material, protection against corrosion, size of carcassing in relation to pressure loss, &c., all find a place in the specification. Of interest are the facts that no service pipe may have a bore of less than 1¼ in., that no pipes with bores smaller than 1 in. may precede the meters, and that no iron carcassing smaller, internally, than ¾ in. may be used.

* Directives pour l'Établissement d'Installations de Distribution de Gaz et la Pose d'Appareils à Gaz. [Zurich, 1936, Société Suisse de l'Industrie du Gaz et des Eaux. Pp. 58.]

Gas Appliances and Air Vitiation*

Two further monographs by R. Grassberger, A. Luszczak, and various collaborators describe a continuation of the work reviewed here some three years ago ("JOURNAL," 1933, 202, 214, and 1934, 206, 913). The useful instrument, the Aerokrit, has again been employed to measure the variation in the oxygen content of a room in which one or other of a range of appliances was undergoing test. At the same time, the possibility of the formation of carbon monoxide in an impoverished and vitiated atmosphere was investigated. In view of the need for suitable methods for the determination of carbon monoxide in low concentrations, this question, also, formed the subject of research. The first of the monographs now under review contains an account of an investigation of the Dräger electrical CO meter for the estimation of small amounts of this gas in air, by E. Hofmann, and the second one includes a description of an investigation of the iodine pentoxide method by O. Fischinger.

In the first monograph, the main theme is the study of the possible contamination of the air of a kitchen with carbon monoxide as a result of the use, respectively, of a gas boiling ring, a modern coal-burning cooker, a paraffin stove, and a petrol stove for the heating and boiling of water. The investigations were purposely carried out under very drastic conditions, ventilation being restricted to an absolute minimum. Indeed, as is evident from the very full details which are given, the investigators put themselves to considerable personal inconvenience and discomfort in carrying out some of the tests. As regards the gas and coal-burning appliances, it was found that perfect safety attends their use when they are properly in-

* Gasgeräte und Veränderung der Raumluft, by R. Grassberger, A. Luszczak, and collaborators. II. Vergleichende Untersuchung von Gasherd, Kohlenherd, Petroleumofen, Benzinkocher. III. Vergleichende Untersuchung von Gasherd und Elektrischem Kochherd, Gasbügeleisen und Holzkohlebügeleisen. Each with an appendix dealing with the estimation of small concentrations of carbon monoxide in air. [Berlin and Vienna, 1935, Urban and Schwarzenberg. Abhandlungen aus den Gesamtgebiet der Hygiene. Heft 18 and 19. Heft 18, pp. vi. + 80. Price R.M. 6, unbound. Heft 19, pp. viii. + 102. Price R.M. 7, unbound.]

stalled, and in the former case, when the grids are sufficiently tall to ensure against smothering of the flames. The oxygen content of the air could fall by as much as 4-5% (actual) and the carbon dioxide content could rise to 3% without formation of appreciable amounts of carbon monoxide. Such vitiation of the air would not be allowed to occur in practice, since the increase in the humidity and temperature of the atmosphere would render conditions intolerable even before this stage were reached and the need for ventilation would not be long in making itself apparent. Conditions were similar as regards the oil-burning appliances, although their good performance is more dependent on a suitably high quality of fuel and on regular attention to cleaning.

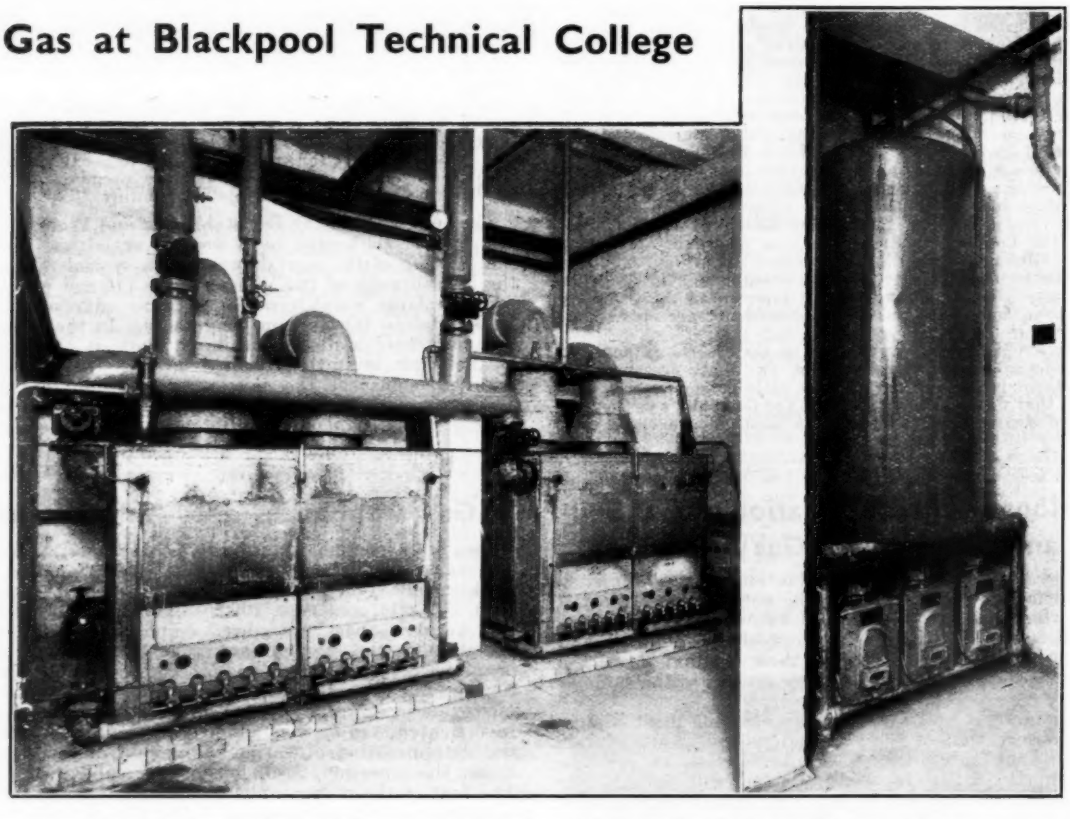
In the second monograph, comparative heating and boiling tests with modern gas and electrical cookers and comparative tests with gas heated and charcoal heated irons are described. The gas heated irons were of the indirectly heated and directly heated types. Production of carbon monoxide was found to be negligible in the case of the gas cooker even when the air had become highly vitiated. Minute amounts of carbon monoxide were evident when the electric cooker was tested, though a dangerous concentration would not accumulate in practice, since the need for ventilation would again manifest itself before this condition could arise. The reason for the formation of carbon monoxide when the electrical cooker was at work is not explained, but this matter is to form the subject of a further monograph. The gas cooker is regarded as superior to the electrical cooker in respect of flexibility, since it can be regulated continuously, whereas the electrical cooker can be regulated only in stages.

With adequate ventilation, gas heated irons can be used safely even in small rooms. The use of charcoal heated irons, except in highly ventilated rooms, is to be deprecated, since much more carbon monoxide is produced than from the gas heated irons.

The two monographs contain a mass of information which amply demonstrates the safety with which gas may be used in the household. They are authoritative and may be warmly commended to anyone who, in these enlightened days, still has any doubts on the subject.

CENTRAL HEATING AND HOT WATER SUPPLY BY

Gas at Blackpool Technical College



Left.—The Central Heating Boilers. *Right.*—Water Heating Boilers and Lagged Storage Cylinder.

The Blackpool Technical College was built at a cost of £50,000 and opened in 1936, having accommodation for 600 scholars.

The College is centrally heated by two gas-fired boilers each with a rated output of 1,300,000 B.Th.U. per hour, situated in the basement of the building. Both boilers are coupled up to the circulating system and can be used together or separately, according to weather conditions. The boilers are thermostatically controlled, being in addition fitted with one clock control on the thermostat weep pipes, which will operate one or more sections as desired. There are 12,762 sq.ft. of radiating surface in the building, including various types of radiators. Circulation is by gravity and acceleration.

To distinguish the main pipes the various services have been painted in different colours, as follows: Hot water, red; cold water, blue; gas, green; fire service, brown; and central heating, bronze. This enables any workman who may have to execute repairs in the future to determine at a glance the correct piping. Two 4,500 cu.ft. per hour high-capacity meters register the gas used by the two boilers, this system being preferred to one large meter.

For water heating there are three gas boilers coupled up in series with a 200-gallon lagged storage cylinder which serves 65 wash basins, each fitted with spring action taps to eliminate wastage of hot water. The secondary circulation is lagged, and further to reduce radiation losses, night valves are fitted, these being operated by the caretaker.

There are approximately 100 other gas points in the College serving various appliances, including a gas engine, small gas-fired steam boiler, two pottery muffle furnaces, brazing hearth, two blacksmith's forges, four large cookers, three gas coppers, Bunsen burners, gas refrigerator, and melting pots. At the rear of the College a gymnasium is in course of erection, where arrangements have been made to install another gas-fired central heating boiler with an output of 520,000 B.Th.U. per hour and a lagged storage set to provide hot water for basins and showers.

Particulars Relating to the Manufacture and Supply of Gas

By Authorized Gas Undertakings in Great Britain for the Year 1935

As Shown by the Board of Trade Return‡

Year.	Number of Authorized Undertakings Included in Return.	Quantity of Gas. Made. Gas from Carbonization of Coal.	Made. Water Gas in Separate Generators.	Made. Total Made.	Sold. To Local Authorities for Public Lamps.	Sold. To Prepayment Consumers.	Sold. To Other Consumers.	Sold. Total Sold.	Length of Gas Mains.
		1,000 Cu.Ft.	1,000 Cu.Ft.	Million Cu.Ft.	1,000 Cu.Ft.	1,000 Cu.Ft.	1,000 Cu.Ft.	Million Cu.Ft.	Miles.
1930	767	255,336,236	39,525,450	313,046*	11,288,866	107,964,634	170,737,354	289,991	50,218
1931	749	254,350,650	40,803,280	313,753*	11,787,528	110,510,440	168,394,815	290,693	51,807
1932	734	251,018,508	38,468,132	309,336*	12,130,576	109,974 360	164,883,077	286,988	53,156
1933	727	249,179,563	39,236,880	309,557*	12,242,631	111,666,260	162,235,458	286,144	54,916
1934	726	257,118,239	32,610,918	313,546*	12,640,257	112,481 528	159,998,266	290,664†	56,928
1935	718	260,505,328	32,354,744	319,342*	13,306 742	113,171 813	162,932,730	295,857†	59,010

Year.	Materials Used in Making Gas. Coal Carbonized.	Materials Used in Making Gas. Coke for Water and Producer Gas.	Materials Used in Making Gas. Oil for Carburetting.	Quantity of Residuals Made. Coke and Breeze.	Quantity of Residuals Made. Tar.	Quantity of Residuals Made. Sulphate of Ammonia.	Number of Consumers. Prepayment.	Number of Consumers. Ordinary.	Number of Consumers. Total.
	1,000 Tons.	1,000 Tons.	1,000 Gallons.	1,000 Tons.	1,000 Gallons.	Tons.			
1930	17,669	790	49,073	11,913	214,762	125,443	5,354,547	3,989,287	9,343,834
1931	17,427	804	53,124	11,732	212,682	103,001	5,560,619	3,997,610	9,558,229
1932	17,001	746	51,749	11,416	211,010	75,728	5,783,449	3,989,566	9,773,015
1933	16,714	749	54,139	11,090	209,983	65,827	6,017,383	3,994,996	10,012,379
1934	17,137	620	40,296	11,396	215,966	71,140	6,312,760	3 964,250	10,277,010
1935	17,294	640	41,679	11,541	219,774	76,701	6,559,123	3,957,636	10,516,759

* Including "Other Gas" and "Coke Oven Gas." † Including "Gas supplied separately for industrial purposes only."
‡ H.M. Stationery Office, Adastral House, Kingsway, W.C., or any bookseller. Price 4s. 6d. net, postage extra.

Coke Oven Gas Purchased

The following quantities of gas were bought from owners of coke ovens by authorized gas undertakings in 1935, and appear in the Board of Trade Return as sold to consumers by those undertakings:

Purchasing Undertaking.	Quantity of Gas Involved.
ENGLAND AND WALES.	1,000 Cu.Ft.
Accrington District Gas and Water Board	575,105
Ackworth, Featherstone, Purston, and Sharlston Gas Company	43,258
Burnley Corporation	545,089
Castleford and Whitwood Gaslight and Coke Company	171,218
Chesterfield Corporation	247,747
Clay Cross Gas Company, Ltd.	95,976
Derby Gas Light and Coke Company	1,311,520
Eckington and Mosborough Gas Company, Ltd.	35,500
Garw and Ogmore Gas Company	14,377
Gas Light and Coke Company	547,378
Haslingden Union Gas Company	56,880
Houghton-le-Spring District Gas Company	90,343
Kettering Gas Company	202,770
Kidsgrove Gaslight Company	54,505
Mansfield Corporation	31,273
Middlesbrough Corporation	1,224,237
Mirfield Gas Company	23,938
Newcastle-upon-Tyne and Gateshead Gas Company	2,799,408
Nottingham Corporation	705,710
Ossett Corporation	148,689
Pontypool Gas and Water Company	47,580
Pontypridd U.D.C.	159,164
Rawmarsh U.D.C.	87,203
Redcar Corporation	177,037
Rhymney and Aber Gas Company	263,111
Rotherham Corporation	963,702
Rothwell Gas Light Company	83,601
Royston and Brodsworth Gas Company	122,479
Sheffield Gas Company	7,098,811
Shirebrook and District Gas Company	12,353
South Yorkshire and Derbyshire Gas Company	191,035
Stocksbridge Gas Company	61,446
Stoke-on-Trent Corporation	182,235
Sunderland Gas Company	478,076
Swinton and Mexborough Gas Board	632,783
Tudhoe and Sunderland Bridge Gas Company	15,890
Wath, Bolton, and Thurnscoe Gas Board	109,563
Wombwell U.D.C.	91,241
Worsbroughdale and Worsbrough Gas Light and Coke Company, Ltd.	29,662
SCOTLAND.	
Glasgow Corporation	722,684
Total	20,454,577

The following is a comparative table of the quantities of gas bought from owners of coke ovens by authorized gas undertakings in Great Britain during the years 1930 to 1935:

Year.	Number of Purchasing Undertakings.	Quantity of Coke Oven Gas Bought.
		1,000 Cu.Ft.
1930	32	13,201,351
1931	31	13,923,456
1932	32	15,441,487
1933	31	16,326,786
1934	33	18,194,054
1935	40	20,454,577

Christmas Fare

B.C.G.A.'s Attractive Booklet

In anticipation of the coming gustatory season a most appetisingly illustrated and well-turned out booklet, in an appropriately gay cover, has been published by the British Commercial Gas Association, and many a housewife will find in it just the inspiration she lacked last year to make her Christmas dinner the great success she would have liked it to be. In its pages the Association have catered for three classes of cooks—those who like to hold by the traditional dishes such as turkey and plum pudding, but do not find all of them very well adapted to present-day conditions; those who prefer a modern menu, lighter and less fattening, but yet want the dishes to have a proper Christmas air about them; and others who would like to experiment with the real old English fare.

Three well-known writers on cookery—Miss Catherine Ives, Mrs. Cottington Taylor, and Miss Florence White—have contributed each her ideas in one of these categories, combining consideration for the cook with kindness to the digestion of the diner, and menus and full instructions are given for the preparation in modern homes, with modern gas equipment, of seasonable fare of all kinds. Both well-tried favourites and less-known dishes are included, and there is no reason why, with the help of the hints in this book, every housewife should not surpass herself in her culinary efforts this year.

Brighton Company Honours a Great Engineer

Memorial Dedicated to the Memory of John Birch Paddon

Last Saturday was a proud day for Mr. A. M. Paddon, Chairman of the Brighton, Hove, and Worthing Gas Company, who must have been extremely gratified at the well-merited tributes which were paid to his father, the late John Birch Paddon—one of the most prominent figures associated with the history of the Brighton Company. Indeed, it was largely due to his energy, ability, and foresight that the Undertaking holds the position it does to-day.

The occasion was the dedication by Sir Charles Morgan, C.B.E., M.Inst.C.E. (a Director of the Company), of a memorial plaque to Mr. J. B. Paddon, which takes the form of a bas-relief tablet set in the wall of the engine house at the Portslade Gas-Works. The ceremony was of a semi-private nature, among those present being, in addition to the present Chairman and Sir Charles Morgan, Mr. G. W. Carey (Deputy-Chairman), Mr. F. H. Jones, Mr. E. L. Burton, Mr. William Cash (Directors), the Rt. Hon. Lord Cautley of Lindfield, Mr. E. V. Evans (Joint General Manager of the South Metropolitan Gas Company), Mr. Hyde C. Burton (Secretary of the Brighton Company), Mr. C. H. Rutter (late Engineer and General Manager), Mr. P. E. Browne (General Manager), Mr. H. V. Corfield (Manufacturing and Mechanical Engineer), and other past and present Senior Officers of the Company.

In order to indicate to what extent the earlier history and progress of the Brighton Company were bound up in the efforts of the late John Birch Paddon, it may be of interest briefly to trace his association with the Undertaking extending over nearly half a century. Mr. J. B. Paddon became Engineer and General Manager of the Company in 1860, and it was he who originally visualized the possibilities of the Portslade site for the erection of a gas-works, offering as it did facilities for bringing sea-borne coal direct to the point of manufacture.

Early Days at Portslade.

The works, as originally constructed, was limited to the present No. 1 Section retort house, engine house (in the wall of which the memorial plaque has been set), purifier house, and ancillary plant, and was designed in 1870 and erected the following year by Mr. Paddon on a narrow strip of shingle between the sea and the eastern arm of Shoreham Harbour. Groynes were constructed to accumulate shingle, and, in addition, Mr. Paddon brought to the site over 30,000 yards of material for levelling. The land thus reclaimed measured about 700 ft. by 400 ft.—approximately seven acres—whereas to-day the Works site covers 40 acres. Originally No. 1 retort house contained four beds of 6 settings each of 8 circular horizontal retorts, 16 in. diameter, having a production capacity of 2 million cu.ft. per diem. The original cost of this section was £72,000, and the works wages bill then amounted to £184 per week. To-day the weekly wages paid at the Portslade Works approximate £1,600.

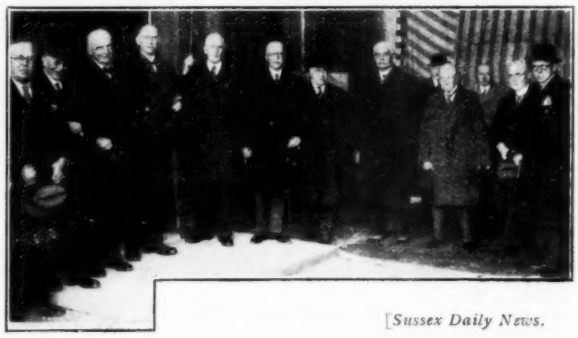
No. 2 Section, a replica of the other, was commenced in 1879 and completed in 1882, when the Brighton Gas Light and Coke Company, with their works at Black Rock, were amalgamated with the Brighton and Hove Company. Gas manufacture for the whole supply area was concentrated at Portslade in 1885—just as it is centred there to-day with an area extending out to Worthing and Littlehampton. Mr. J. B. Paddon retired from the position of Engineer and General Manager at the end of 1885, when he was elected to a seat on the Board, subsequently becoming Chairman of Directors in 1900, from which position he retired in August, 1903. No. 3 Section of the Works, consisting of settings similar to Nos. 1 and 2, was commenced in 1891 and completed in 1895 while Mr. Paddon was still a Director.

Mr. J. B. Paddon was elected to Associate Membership of the Institution of Civil Engineers in 1861 and to Membership ten years later. He read a Paper before this body descriptive of the construction of the Portslade Works in 1874. Like his son, Mr. Paddon's interests were not confined to the Brighton Undertaking, and a number of other gas companies had the benefit of his able services in various capacities. He acted as Engineer to the Southampton and Winchester Gas Companies, as Consultant to the Richmond, Lewes, and other undertakings, and as Director of the Gas Light and Coke Company and several suburban companies. He was, in addition, an expert Parliamentary witness from 1870 to 1885. Mr. J. B. Paddon died in 1910, and it is very fitting that a memorial should have been set up to him at the Works which he must have had most at heart and which themselves stand to-day as the greatest tribute to his abilities.

THE DEDICATION.

Those present for the dedication ceremony gathered at the outset in the works fire station, close to the site of the memorial. Here, Mr. A. M. PADDON, who presided, said he never heard his father evince any form of personal pride save in the exercise of his profession as a Civil Engineer. Of that profession Sir Charles Morgan, who had kindly consented to dedicate the memorial, was at once the doyen and, in the estimation of his colleagues, the most prominent member.

Sir CHARLES MORGAN then spoke and referred in detail to the late Mr. J. B. Paddon's distinguished career, observing that no Engineer of whom he had any recollection had been continuously responsible for such important work as Mr. Paddon carried out at Portslade. It must, said Sir Charles, be a matter of pride to Mr. A. M. Paddon that they were gathered there to do well deserved honour to his father. Their present Chairman had qualifications equal to those of his father; he was most popular with his fellow Directors and they were very proud of such a Chairman, who must greatly resemble his father. It was a pleasure to him to be there on that occasion, as he was certain it was to his colleagues.



[*Sussex Daily News.*

A Group at the Unveiling Ceremony.

Mr. E. L. BURTON said he regarded it as a great privilege to be permitted to say something of one whose memory he revered above all those with whom their business had brought him into contact during a period of fifty years. Providence directed his steps to 5, Great Winchester Street, in 1885, and there he first established contact with one who was to become his Chief in the years that followed. Later, when Mr. Paddon became a Director of the Company, he was brought into closer contact with him. To that contact and the great example Mr. Paddon set he owed much of such success as he had achieved in the course of his business life. He was a disciplinarian, but it was a discipline rather by example than otherwise. He was rather severe on the slacker and upon those who had not come up to the standard he expected of all those who served him; but Mr. Burton believed the great majority of those who served him attained to that standard by the force of his example and kindliness, because if he was stern in one connection he was the very acme of kindness in others. Mr. Burton looked upon those happy years, when he saw him from time to time and received words of wisdom and kindness from Mr. Paddon, as some of the best of his life; and he stood there to-day as one who was very greatly beholden to John Birch

Paddon. He left him a legacy of service to his son, and for the last 35 years it had been his happiness to work with Mr. A. M. Paddon and to see reproduced in him many of the qualities and many of the high attainments and the other brilliant gifts which his father had. He bowed himself to the memory of Mr. John Birch Paddon, and he bowed to Mr. A. M. Paddon, a worthy successor to his father so far as all those who have worked under him were concerned.

The party then proceeded to the memorial, which Sir Charles Morgan unveiled. In doing so he said: "I hope that all who go through these works, be they Directors, Managers, or workmen, when they look up and see this plaque will regard it with affection and with remembrance of Mr. Paddon as being one of the most brilliant Engineers in connection with this class of manufacture, and one whose example I hope they will take the greatest pleasure in following. I shall never pass it without looking up and thinking of what he was and what he did."

Luncheon was afterwards served in the offices.

Mr. A. M. PADDON, who was in the chair, thanked Sir Charles Morgan for having given "the imprimatur of his distinguished position as an engineer" to the ceremony, and complained of the unmerited obscurity to which the civil engineer had been relegated compared to members of the learned and artistic professions. "Like Atlas he holds up the world without the world knowing it. He will endure, however, because he alone is the master alike of mind and matter."

Sir CHARLES briefly responded.

Lord CAUTLEY, called upon by the Chairman, said he had been particularly struck since he had been connected with the Company with the energy and skill displayed by everybody associated with it, from the highest to the lowest. With regard to the late Mr. Paddon, he could not help feeling that his real memorial lay in the works themselves. The judgment and force of character which made him select that site on an inhospitable shore, and which enabled him to carry the design through, had in them a fitting monument. In his son and successor they saw the same force of character, the same readiness of decision, and the same determination to overcome difficulties.

The health of the Chairman was cordially offered on the proposition of Mr. G. W. CAREY.

Water Softening by the Base Exchange Process

A further extract from the Presidential Address of Mr. R. Summerson, of Luton, to the London and Southern District Junior Gas Association on Oct. 16.

In order to maintain the thermal efficiency of works boilers and to prolong their life, it is necessary to give most waters intended for boilers a preliminary treatment. Such treatment involves one or both of two processes: (1) softening, which removes scale forming constituents in the water; (2) Conditioning, which ensures that the water fed to the boilers will not give rise to corrosion and caustic embrittlement.

It is not my purpose here to deal with the subject of the conditioning of boiler waters. For the benefit of students and others who wish to pursue this subject, I give a reference (*) at the end of this Address.

Of the various ways of softening water, I have selected the Base Exchange Process. In view of the lack of available information on this subject in the volumes of the Joint Junior Transactions, I hope the few notes I am about to give will prove of interest to works juniors and also to distribution men who may have to consider the installation of domestic softeners to maintain the efficiency and life of water heaters. The application of domestic softeners does, however, require a little discrimination: it is not essential to soften water for lavatory flushings and car washing.

The term "Base Exchange" refers to the property which certain hydrated aluminosilicate possess of exchanging the metal combined with the aluminosilicate radicle with another metal under suitable conditions. This reaction is reversible, thus: Na_2O, Al_2O_3, $\times$ SiO_2, y H_2O + $CaCl_2$ $\rightleftarrows$ CaO, Al_2O_3, $\times$ SiO_2, y H_2O + $2NaCl$.[1] By making use of this reaction, the calcium and magnesium ions may be removed from hard water and replaced by sodium ions, which are non-scale forming. When the available sodium in the aluminosilicate has been exchanged for calcium in this way, the aluminosilicates are regenerated by means of sodium chloride solution (brine) which replaces the sodium base in the aluminosilicate, and the calcium is removed as calcium chloride in the spent brine.

Base exchange materials are usually refered to as zeolites. Of these there are two main types: (1) A group of naturally occurring minerals, which are given some form of preparation and grading before marketing. (2) A group of zeolites which are manufactured synthetically, and graded.

Properties of Zeolites.*

All zeolites are characterized by what is known as their exchange values. This is the amount of hardness that a unit volume or weight of zeolite can remove from the water, and it is usually expressed as the equivalent weight of lime (CaO) or calcium carbonate ($CaCO_3$) in lbs. of grains exchanged per cu.ft. of zeolite. The base exchange value may vary with:

(1) The type of zeolite. Synthetic zeolites under usual working conditions will remove approximately 0·8 lb. of CaO per cu.ft., while a good natural zeolite will remove about 0·4 lb. of CaO per cu.ft.—*i.e.*, 500 gallons of water with 20 degrees of hardness could be softened to zero by 1 cu.ft. (50 lb.) of synthetic zeolite or by 2 cu.ft. (174 lb.) of natural zeolite, before the zeolites require regeneration.

(2) The depth of bed, usually being greater the deeper the bed.

(3) The rate of flow, especially in the case of synthetic zeolites. With the natural zeolites, the reaction is a surface one, but the synthetic zeolites are porous materials and time is necessary for the efficient utilization of the available sodium in the bed.

(4) The size of the zeolite grains, being greater the smaller the grains. For example, a synthetic zeolite graded to pass a 30 mesh and stay on a 50 mesh square screen has a capacity about 50% greater than the same zeolite graded to pass a 10 mesh and stay on a 30 mesh screen, for the same conditions of speed, temperature, water, &c. Unfortunately, the smaller grade cannot be so widely used on account of its high resistance to the flow of the water.

(5) The amount of salt used in regeneration. The exchange values of natural zeolites are independent of the amount of salt used in regeneration provided this exceeds a certain minimum quantity, but the exchange value of synthetic zeolites increases with the amount of salt used and may be almost doubled by the use of excessive amounts of salt.

Other factors which have an effect upon the softening capacity of a given quantity of zeolite are:

(1) The quantity of magnesia present in the water. The reaction between zeolites and magnesia is slower than that between zeolites and lime, and, moreover, the zeolite has a greater affinity for lime. Consequently, for waters containing appreciable quantities of magnesia, a greater quantity of zeolite is used.

(2) The initial amount of soda in the water. The softening reaction can only proceed until equilibrium is reached, and this occurs when the ratio lime and magnesia to soda in the grain is equal to the ratio of lime and magnesia in the water. This ratio is reached more rapidly in the grain if the water initially contains an appreciable amount of soda, and therefore the softening capacity of a given amount of zeolite is proportionately reduced. Furthermore, the substitution of soda for lime and magnesia in the water reduces the amount of work it is possible to do in the lower layers of the bed. Consequently, a greater quantity of zeolite is required for waters of high lime and magnesia content.

(3) The temperature of the water. The reaction proceeds more slowly at low temperatures than at high temperatures. Generally speaking, the temperature of the water to be softened should be between 5° and 20° C. Below 5° the reaction is appreciably retarded: above 20° C. the rate of solution of zeolites in water increases rapidly.

The size of a base exchange plant is therefore deter-

* The Author informs us that since the Paper was written he has learnt that a natural zeolite has been placed on the market, from which a base exchange capacity nearly equal to that of synthetic zeolites is claimed.

mined by the makers from a knowledge of the composition of the water, the softening-regenerating cycle and rate of flow desired, and the exchange value of the zeolite under those conditions.

The design of base-exchange water softening plants requires careful consideration. The first cost of a plant should be considered together with the ultimate maintenance charges which it is estimated will be incurred. Additional capital outlay in the first place may secure ultimate economy.

In the usual design the zeolite is contained in one or more closed vertical steel cylinders which are fitted with distributors at the top and bottom of the cylinder. The distributors are of primary importance since, by these, even distribution and uniform percolation of water through the zeolite bed is ensured, and similarly of the salt solution and water used in regenerating and washing. Probably the most satisfactory type of bottom distributor is one consisting of a cast-iron header with wrought-iron laterals into which nozzles, fitted with finely perforated plates, are screwed at centres from about 5 in. to 6 in. The whole distributor is then embedded in concrete and the surface of the concrete finished off practically flush with the top of the nozzles. This gives a flat floor on which the zeolite can be placed directly without the use of any gravel, thus avoiding salt pockets and facilitating the cleaning of the plant when necessary. The top distributor may consist of a perforated plate extending the whole diameter of the container.

The size of the zeolite containers is usually such that regeneration takes place every 10 or 12 hours. It is advisable to allow a free space above the surface of the zeolite bed of approximately 50% of the bed depth in order that the material can be thoroughly back flushed without danger of washing any useful zeolite grains out of the plant. Occasional back-flushing (that is, passing water in an upward direction through the zeolite bed) is desirable in order to remove any dirt which may have been filtered out of the water (which usually flows in a downward direction through the bed). Back-flushing also rearranges the particles of zeolite so as to give a uniform resistance to the flow of water.

An important point in the design of these plants is their power of resistance to corrosion. Additional capital expenditure in this case may well be repaid in reduced maintenance. Conditions are severe: the plant has to resist attack by water, brine, and air. Monel metal and heavy gauge brass have been found to be satisfactory for distributors. Steel work must be protected by the best known means. Brine tanks may be of timber or concrete tanks lined with asphalt or rubber-lined steel tanks.

Salt Consumption and the Regeneration Process.

The first principle which must be observed if efficient use is to be made of the salt is to pass the brine through the bed in the opposite direction to that in which the water has been flowing during the softening period. The brine is thus usually passed in an upward direction.

The amount of lime removed by the brine is at its maximum at the commencement of the regeneration and steadily diminishes as the regeneration nears completion. In consequence of this, it is possible by a suitable arrangement of tanks, &c., to recover that portion of the brine which has only been partially used and to use this material for the first stage of the following regeneration, the spent brine being run to waste. When using this salt recovery system, it is advisable that the capacity of the partially spent brine tank should be approximately 10% greater than the net water capacity of the softening unit. The new brine tank should also be of the same capacity. In this way, complete displacement to waste of the spent brine from the unit is ensured during regeneration.

Economical softening is not obtained by operating zeolite at its maximum base-exchange value. In the case of synthetic zeolites, the efficiency of regeneration is entirely dependent on the amount of zeolite that is used relative to the quantity of water treated. For the usual quantity of zeolite employed, something like 5 lb. salt is used per lb. of lime removed. If 50% more zeolite is used, the ratio of salt used to lime removed becomes 4:1. If double the normal quantity of zeolite is employed, the ratio becomes 3·5:1, while if five times the normal quantity of zeolite is employed, the theoretical efficiency of 2·09 lb. of salt per lb. of lime can be attained. In large plants, the cost of softening may be reduced by employing the larger quantities of zeolite in order to obtain a salt/lime ratio of 4:1. In these cases the saving on salt may be much more than the interest on the cost of providing the additional zeolite.

The strength of the brine employed is approximately 5%, but varies according to the system of regeneration and design of the plant. It is advisable to filter all brine before pumping it to the softener in order to remove all bag fibre and insoluble impurities which may tend to block the bottom distributors or clog the zeolite.

It is now possible to substitute for the usual manual control of softening, backwashing, brining, and rinsing an electrically operated fully automatic controller.

In a well designed plant the volume of water used for regeneration and washing should not exceed about 2½% of the volume of water softened to "zero" with hard water of about 18° English. Wastage varies directly with the hardness.

A Comparison of Synthetic and Natural Zeolites.

Synthetic zeolites are relatively delicate chemical products subject to permanent damage or serious wastage except when used with understanding and in carefully selected cases. The practical advantages of synthetic zeolites are: (1) A smaller plant can do the same amount of softening. For this reason, they are widely used in domestic softeners. (2) The consumption of salt is less. (3) The amount of waste water is less. The chief cause of damage and wastage of synthetic zeolites are: (1) Presence of acids, principally free carbonic acid, which attacks the active base; and absence of silica in the water, causing wastage by solution. Free carbonic acid may also cause occlusion of the pores. (2) Presence of suspended matter, iron or manganese in the water, causing clogging and structural damage of the zeolite. (3) Too rapid a rate of filtration or too vigorous back-washing causing wastage by attrition.

Free CO_2 may be removed by spraying or cascading, and provided the total content of free CO_2 in the water does not exceed 10 parts per million, the rate of action on the zeolite is negligible. Zeolites suffering from the effects of low silicate waters may have their capacity restored quite cheaply by occasional treatment with sodium silicate solution. Insoluble iron and other insolubles which might clog the pores of the material should be removed by filtration.

Natural zeolites have the following merits over synthetic zeolites: (1) They are more robust; (2) the velocity of the base exchange reaction is very high: a high rate of filtration may be employed. Regeneration is rapid; (3) they are not affected by acids and may even be cleansed by acids; (4) they are not permanently damaged by suspended matter, iron, &c., in the water, and they may be vigorously back-washed to remove suspended matter which has been filtered out by the zeolite.

The Choice of a Softening Process.

It is absolutely essential before deciding on the type of softening process to be employed to obtain adequate analytical data about the water which is to be softened.

Generally speaking, waters which are acid or corrosive contain suspended matter, or iron or manganese in solution, or have a high sodium content, are more suitably softened by the lime process. Waters of high magnesia content or high permanent hardness are best softened by the base-exchange process, especially when variable in composition.

If a water which is high in temporary hardness is softened by the base exchange process, the resultant soft water has a high content of sodium bicarbonate. This may give rise to corrosion in the boilers by the liberation of carbonic acid, while the formation of sodium carbonate and caustic soda in the concentrated water in the boiler may cause caustic embrittlement unless great care is taken to ensure that the correct hydrate/sulphate ratio is maintained.

The combined process is claimed to possess the advantages of each process and to be particularly suitable for waters of high temporary hardness. The lime removes the greater part of the temporary hardness; the zeolites remove the remainder, together with the permanent hardness. In this way an excellent boiler water is produced.

The combination of the two processes is, however, by no means a simple matter, and requires considerable care. It is of primary importance that the water leaving the lime plant shall be of suitable character for passage over zeolites, otherwise the zeolites may easily be ruined. The important points are: (1) that the lime softening reaction shall be quite complete. Otherwise the reaction may be completed during passage through the zeolite bed, with consequent deposition of calcium carbonate on the zeolite grains; (2) that the water shall be perfectly clear: if not, the zeolite becomes an excellent filter to the detriment of its softening properties; (3) that the water shall not be excessively alkaline, in order to avoid attack on the zeolite; (4) that there shall be no free lime in solution. Zeolites may, in the case of synthetic zeolites, absorb lime directly: this then may react with residual CO_2 in the water, resulting in the formation of crystalline calcium carbonate in and between the grains, cementing the grains together into a hard mass.

Concluded on p. 611.

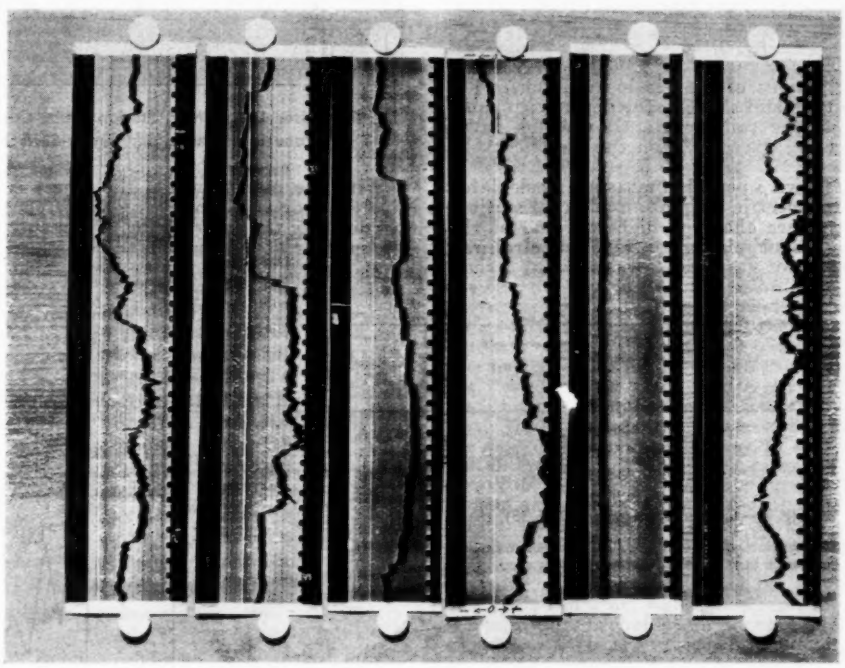
A NEW METHOD OF Measuring Stray Currents

A Symposium from the "Das Gas- und Wasserfach," 1936, No. 1; the Swiss Electro-Technical Association, 1936, No. 14; the Journal of the Association of the Belgian Gas Industry; discussions at the second meeting of the Commission Mixte Internationale, 1936, and reporting work of Dr. W. Beck, Commission Mixte Internationale (C.M.I.) Paris; and Dipl. Ing. Böninger, Berlin Gas-Works, in conjunction with Dr. A. Bahrdt, "Denso" Laboratories, Berlin.

Fig. 1.—A View of the "Denso" Laboratories, Berlin.

During recent years scientists and technicians have devoted their efforts to an increasing extent with grappling with the problems arising in the measuring of stray currents in the earth. The cause of these stray currents and the extent of the damage they cause to pipes, cables, and metal work in the ground can be taken as understood.

Thanks to the progress made, a new process has been developed which has proved particularly effective under practical conditions. This method utilizes the so-called loop galvanometer, suggested in the first place by the British Post Office and perfected by the practical work of Dr. Beck, of the Institute for Physical Chemistry of the Warsaw University, and Dr. A. Bahrdt, of the corrosion research laboratory belonging to the manufacturers of "Denso."[1]



I. II. III. IV. V. VI.

The Zeiss loop galvanometer is, briefly, an apparatus whereby electrical impulses affect a thin aluminium loop suspended between magnets and surrounded by a magnetic field. The loop moves in accordance with the strength of the current and in these experiments the movements are photographed cinematographically. The instrument has only a very small internal resistance and is extraordinarily sensitive to current.

In this article we illustrate a few practical measurements with the instrument which were made on pipes in the vicinity of a sub-station of an electric railway. The readings were on two lead service tubes of 25 and 40 mm. diameter which convey the cooling water for the rectifier of the sub-station. We reproduce some cuttings from the films taken. The long white perpendicular line on the film is the zero line.

Film I. shows photographic registering of the drop in resistance over a piece of the 25 mm. pipe 2·11 metres in length.

Film II. gives the fluctuations taken by an electrical probe of the readings in the interior of a wall of a house.

Film III. shows the same measurements as II., but taken at a different time of day.

Under IV. one sees the tension difference between the 25 mm. and the 40 mm. tubes.

Films V. and VI. must be examined separately. They are readings made on a different object—namely, pipes which are laid along the banks of a river and which were damaged by corrosion. Near these pipes were a number of coal cranes worked by direct current.

Strip V. shows the character of the current as shown by a probe explained later. The measuring was done after the crane had ceased work.

VI. shows the electrical tension of the same tube registered against a reference electrode introduced into the ground (distance of the earth rod from the pipe 50 cm.). The particularly disturbed character of the current is very noticeable, while the current found after working hours was extremely small and showed hardly any fluctuations.

The electrical probe mentioned was used by us[2] at first to measure the stray currents of iron pipes. Like the loop galvanometer it was suggested by Michalke[3] for measurements on long distance cables and later tried out by Messmer[4] and Haehnel.[5] The probe consists of a small circuate section of the same material as the tube upon which the measurements are to be made.

It is applied firmly to the surface of the tube, but insulated therefrom, and, in our case, connected with the loop galvanometer lead.

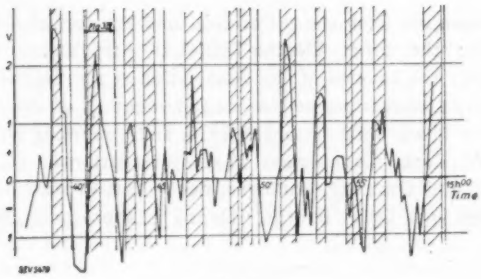


Fig. 2.

If the pipe discharges a current, then the probe electrode also discharges, which, owing to a short circuit with the pipe, possesses the same earth potential as the pipe[6]. As the area surface of the electrode is known, one can ascertain the density of the current, for example, per sq.cm. and obtain a positive picture of the danger of corrosion. In one case a hole was made in the wall—the probe mounted and firmly cemented in.

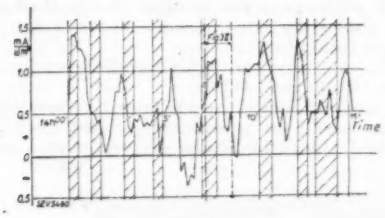


Fig. 3.

In fig. 2 the fluctuations of the tension differences are given in relation to time and showing the dependence upon the traffic of the electric railway trains, whereas fig. 3 shows the corresponding diagram from the electric probe readings.

By the shading is shown a period of measuring calculated from the arrival of the electric train at an adjacent station.

It is of no consequence that the highest value of the tension bears only a casual relation to the electric railway traffic; figs. 3 and 4[7] show a similar result. In fig. 4 the middle values of the tensions between the two pipes are recorded in relation to time, one during the passage of the train and one when it had stopped. It is noteworthy that the passing of a tram in front of the house is also clearly to be observed.

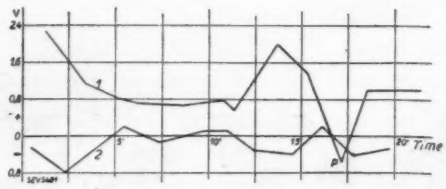


Fig. 4.

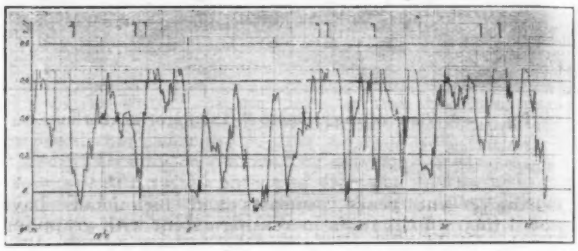


Fig. 5.—Kaiser Friedrichstr. Station. Tension Pipe-Earth (10.9.35).

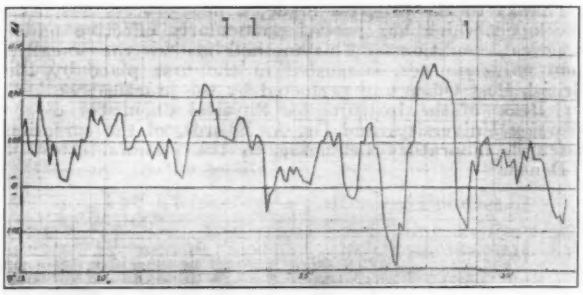


Fig. 6.—Kaiser Friedrichstr. Station Probe Current (Current Pipe-Probe in Milliamps/dm² Probe Surface) (10.9.35).

With the measurements the object is to show the relatively important currents and differences in potential and particularly the ascertaining of currents which escape from the interior of the walls of the house.

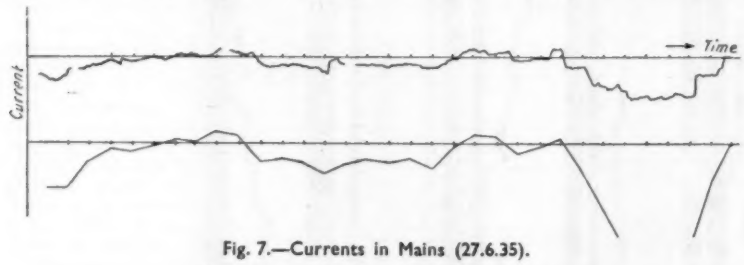


Fig. 7.—Currents in Mains (27.6.35).

Above in a water main; below in a gas main.
Distance between the time marks = 5 sec.

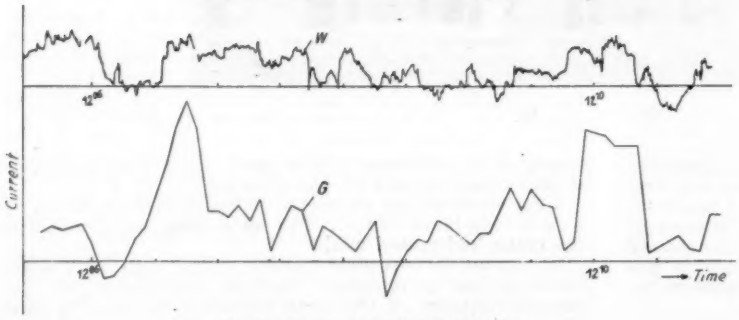


Fig. 8.—Currents in Mains (27.6.35).

W = in a water main. G = in a gas main.
Distance between the time marks = 30 sec.

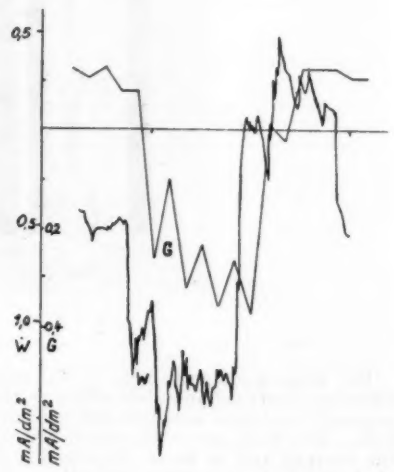


Fig. 9.—Currents Leaving the Main (27.6.35).

G = Gas main. W = Water main.
Distance beneath the time marks = 1 min.

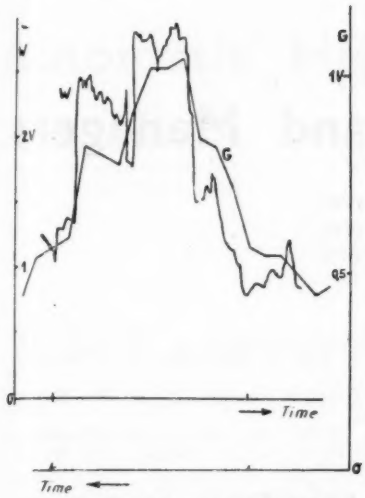


Fig. 10.—Main Potentials (27.6.35).

G = Gas main. W = Water main.
Distance between the time marks = 1 min.

In completion of this work we refer to the measurements which were carried out on an oil gas pipe which ran parallel to a rail of an electric railway for a very considerable length.[8] The flanges of the oil gas pipe lie in air shafts and have insulating layers between them. The two graphs, figs. 5 and 6, show the values of the probe current and the tension pipe/earth.

From these pictures we can easily see that there is a clear connection between the earth current and the train traffic. The marks portray the following:

] A train at this moment is travelling in direction N.
] A train is travelling in direction T.
] A train is travelling on the branch line to station K.

The ascertained earth current densities are of very small order of magnitude and, as a matter of fact, no serious corrosion has been found on the pipe mentioned during the five years that the line has been electrified.

From the measurements it can be seen how minute tension and current losses can be ascertained by the loop galvanometer. The electric probe also indicates readily the smallest and greatest current fluctuations. There follow some other measurements for the purpose of comparison made with the loop galvanometer and measured parallel to a water pipe on a neighbouring gas pipe by the usual method and clearly establishing from time to time that currents measured with an indicating instrument were directly registered.[9]

Fig. 7 shows the film of the current in the water main and the synchronous record of the current in the gas main. On the whole the characteristics of the two currents are practically the same, so that the same cause must be responsible for the currents in the two mains. It is not possible, however, to ascertain from these comparisons whether still another current is flowing in the one, which cannot be traced in the other main, as other synchronous

Fig. 11.—Main Potential (10.9.35).

Distance between the time marks = 5 sec.

measurements would suggest. The case illustrated in fig. 8 is different. It illustrates the characteristics of currents flowing in the same gas main, and in another gas main, which is lying close to the first. Other measurements had already shown that the similarity between the two currents was not so pronounced, which is also evident from the illustration. Strong current impulses at 12 h. 6 m. 45 s. and at 12 h. 10 m. 0 s. occurring in both mains indicate that both currents have the same origin, although they are otherwise not very similar.

Illustration figs. 9 and 10 show a different ratio between the scale of abscissæ and ordinates which accentuates the high peaks recorded by the loop galvanometer. The results of the synchronous measurements, which are also recorded in these illustrations, confirm the faithful reproduction of the results. In fig. 10 the zero line is not the same for both tests, in order to correct the effect of the different materials of the pipes (the gas pipe was iron, while the water pipe was lead and the ground electrode was zinc). Fig. 9 illustrates the difficulties arising in ob-

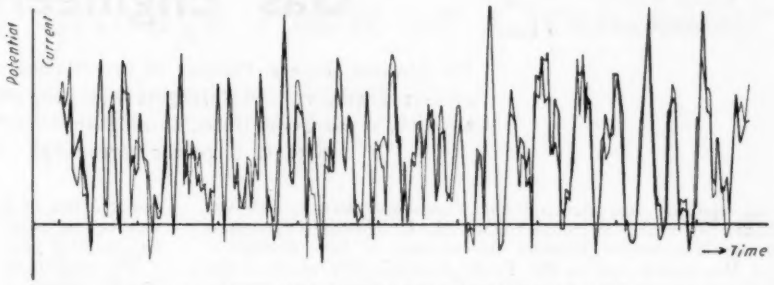


Fig. 12.—Potential of Current in Rail and Main (17.7.35).

Distance between the time marks = 5 min.

taining exact synchronization. In the test great care was taken with regard to the time record, but in spite of this the two records seem to differ by 5 to 6 seconds. At the time that the measurements were taken it was not known whether the two records should coincide, and for this reason it is possible that a mistake was made. In these cases it is best to work with two loop galvanometers or two identical indicators.

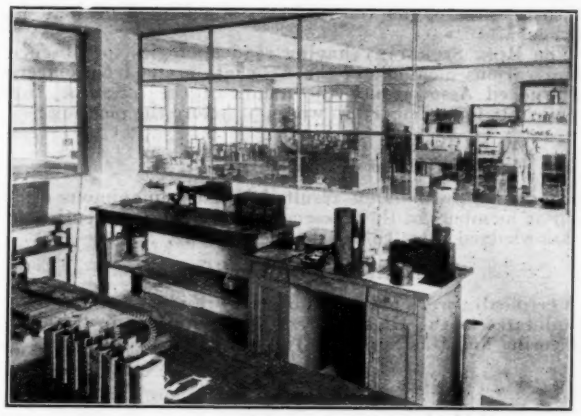


Fig. 13.—Another View of "Denso" Laboratory, Berlin.

In order to investigate to what extent the two records deviate from one another, when mean values are taken, in one test the same value was recorded by means of the loop galvanometer and by spot readings from an indicator. Fig. 11 shows this section of the record. The indicator readings coincide generally satisfactorily with the film. The mean values obtained from the spot readings show but few deviations from the true mean values calculated from the film. The difference is naturally somewhat greater when spot readings are taken, not every 5 seconds as in the case of this test, but every 10 seconds as indicated by the dotted line. The differences are of the same order of magnitude as those mentioned in the first report of the Swiss Corrosion Committee.

Film records are, therefore, advisable in all cases where it is not possible to ascertain different influences by simple synchronous readings, or when further investigations are desirable. Thus, some tests have produced sinous curves of a period of 7 hr. which, however, faded out after 1 to 2 seconds, and probably were caused by the operation of switch gear. In the investigation of such currents or those of higher frequency a film is used with advantage.

REFERENCES.

[1] Bulletin of the Swiss Electro-Technical Association, 1936, No. 4.
[2] W. Beck: Trans. Inst. Gas Engr., 1933, No. 69.
[3] C. Michalke: Elektr. Kraftbetr. u. Bahnen, Bd. 7 (1909), s. 226; z. Verkehrstechnik Bd. 9 (1922), s. 114; Etz. Bd. 44 (1923), s. 329.
[4] T. D. E. Messmer: Telgr u. Fernsprechtechn. Bd. 10 (1921), s. 117, 140.
[5] O. Haehnel: z. Fernmeldetechn. Bd. 4 (1923), s. 35, 49.
[6] Must only be taken as approximate.
[7] From earlier measurements with less sensitive instruments this connection could not be obtained with certainty.
[8] Will be published shortly in a Continental journal (work by Beck and Bahrdt).
[9] See also "Das Gas- und Wasserfach," Vol. 9 (1936), No. 1.

Midland Association of Gas Engineers and Managers

Autumn Meeting at Birmingham

The Autumn General Meeting of the Midland Association of Gas Engineers and Managers was held on Thursday, Nov. 19, at the Grand Hotel, Birmingham—the PRESIDENT (Col. G. S. Eunson) presiding.

In opening the meeting the PRESIDENT first of all extended a hearty welcome to Mr. A. L. Holton (President of the Manchester District Association of Gas Engineers and Managers) and to Mr. F. A. Jenkins (President of the Midland Junior Gas Association), which these two gentlemen briefly acknowledged, thanking the Association for their kind invitation to attend their meeting.

The HON. SECRETARY AND TREASURER (Mr. J. H. Paterson, of Ludlow) then read the minutes of the previous Annual General Meeting and Spring Meeting, which were duly confirmed and signed, after which the PRESIDENT referred to the loss the Association had sustained in the death of two members—namely, Mr. W. Prince, of Tipton, and Mr. J. Belton, late of Chester, who passed away only the previous Tuesday; he also referred with regret to the death of Mr. J. C. Walker, General Secretary of the British Commercial Gas Association. In tribute to the memory of these three names the members stood for a moment in silence.

The HON. SECRETARY having read apologies for absence from various members of the Association and from officers of kindred Associations, the names of the following two applicants for membership were put before the meeting:

W. K. Parsons (Daventry).
D. Green (West Bromwich).

The subsequent ballot resulted in their unanimous election as members of the Association, and the two gentlemen acknowledged their thanks to the meeting.

Presentation of Certificates.

Certificates were presented by the President to successful candidates in the Higher Grade Examinations in Gas Engineering and Gas Supply. The full list is as follows:

Gas Engineering (Internal).

W. D. Cadwallader	Birmingham	1st Class
V. H. Deacon	"	"
F. Harvey	Hagley	"
W. L. Hathaway	Birmingham	"
T. W. Roberts	Dudley	"
J. G. Tilley	Halesowen	"
W. N. Butlin	Birmingham	2nd Class
G. T. Phillips	"	"
T. W. E. Shipley	Nottingham	"
F. N. Tidball	Coventry	"
B. W. Wardle	Nottingham	"

Gas Engineering (External)

G. J. Rimmer	Hinckley	1st Class
D. K. Howgate	Wolverton	2nd Class
F. L. Whitehurst	Cheadle	"
C. A. Young	Shrewsbury	"

Gas Supply (Internal).

A. R. Bate	Birmingham	1st Class
M. R. Fisher	Leicester	"
J. G. Tilley	Halesowen	"
J. White	Cradley	"
R. N. Brookhouse	Leicester	2nd Class
J. R. Hunt	Stourbridge	"
L. V. S. Mann	Birmingham	"
F. W. Sidaway	Cradley Heath	"
N. R. Taylor	Birmingham	"

Gas Supply (External).

D. A. Foster	Wellingborough	1st Class

New Officers and Committees.

Mr. E. B. TOMLINSON (Birmingham) then proposed that Mr. Harold Davies, of Chesterfield, be elected as their President for the ensuing year. They all knew, he said, what an active member of the Association Mr. Davies had been and with what energy he carried out everything to which he put his hand.

The proposition was seconded by Mr. R. S. RAMSDEN (Leamington), who referred to other important offices which Mr. Davies had occupied in the Industry and the Association of Public Lighting Engineers. They were fortunate, he said, that he had accepted the Presidency for the coming year.

The resolution was carried unanimously, and Mr. DAVIES briefly returned thanks.

On the proposition of Mr. G. DIXON (Nottingham), seconded by Mr. W. G. S. CRANMER (Willenhall), Mr. F. Davies, of Walsall, was elected Vice-President, the proposer remarking that it was a coincidence that they should have two brothers following in their Presidential Chair.

It was moved by Mr. A. ROBERTS (Hereford) and seconded by Mr. T. POULSON (Stafford) that the following four members be elected to the Committee—namely, Messrs. T. Thornton (Rowley Regis), J. H. Wainwright (Halesowen), C. F. W. Rendle (Redditch), and F. Shewring (Stratford-on-Avon). This was unanimously carried.

On the resolution of Mr. C. H. WEBB (Stourbridge), seconded by Mr. A. H. CRANMER (Wolverhampton), Messrs. G. Dixon (Nottingham) and C. F. Dakin (Cradley Heath) were appointed Auditors of the Association.

Proposing the re-election of Mr. J. H. Paterson as Hon. Secretary and Treasurer, the PRESIDENT remarked how grateful they were to Mr. Paterson for all he had done for the Association during the past year. In him they had an excellent Secretary and Treasurer, one who had the full confidence of all the members and who had the interests of the Association at heart.

This resolution was seconded by Mr. G. C. PEARSON (Birmingham) and carried unanimously, Mr. PATERSON briefly acknowledging his thanks.

Two Papers were then presented as follows: "Reconstruction at Stratford-on-Avon Gas-Works," by Mr. F. Shewring; and "Automatic High-Pressure Compressing and Storage Plant at Cirencester," by Mr. J. G. Cleator.

Athletic and Social

Cambridge Recreation Club.

The Cambridge University and Town Gas Light Company's Recreation Club held a supper on Saturday, Oct. 31, in their Club Rooms in celebration of the winning by the Bowls Team of the "Gilbert Cup" which is open for competition in the Cambridge and District Bowls League.

The Chair was occupied by Mr. J. Hunter Rioch (Engineer and Manager), who was recently elected a Vice-President of the Club, supported by Mr. W. G. Bradford (Accountant); Mr. H. Sword (District Superintendent); Mr. E. H. Winch (Chief Technical Assistant); and Mr. A. Bowman (Chairman of the Recreation Committee).

Mr. A. Bowman, on behalf of the Club, extended a hearty welcome to their new Engineer and Manager. In presenting Replicas of the Cup to each member of the Bowls Team, Mr. Rioch said it was apparent that in the Bowls Section they had the team spirit. He assured them of his support and expressed his pleasure at the large gathering.

Perth Gas Department Social.

The staff of the Perth Corporation Gas Department and friends held their second annual whist drive and dance in York House on Wednesday, Nov. 11. Mr. David Vass, Engineer and Manager, extended a welcome to the company, numbering 160, which included Mrs. D. Vass; Ex-Bailie A. Gowans, Convener of the Gas Committee, and Miss Gowans; Mr. A. C. Rea, Assistant Gas Engineer, and Mrs. Rea; Mr. A. Wilson, Works Manager; and Mr. T. R. Sawers, Assistant Distribution Superintendent. Whist was played under the direction of Mr. L. Locke, and at the conclusion Ex-Bailie Gowans expressed his pleasure at again being present at the Gas Department's Social, and complimented the Gas Manager and the Staff on the excellent results produced during the past financial year and on their endeavours in meeting the competition of the electrical industry. Mrs. Vass was called upon to present the prizes to the whist winners, and was cordially thanked for her services on the call of Mr. A. C. Rea. A vote of thanks to the donors of the prizes was accorded on the motion of Mr. A. W. Langlands. After supper, there was dancing.

Automatic High-Pressure Compressing and Storage Plant at Cirencester

by
J. G. CLEATOR
(Engineer and Manager of the Cirencester Gas Company)

A Paper presented at the Autumn General Meeting of the Midland Association of Gas Engineers and Managers held at the Grand Hotel, Birmingham, on Thursday, Nov. 19.

With the modern tendency to build houses on the outskirts of a gas undertaking's area, where the mains are usually small, many gas undertakings find it increasingly difficult to maintain an adequate pressure in the more distant mains at times of peak load. To give satisfactory service it is essential not only to maintain sufficient pressure, but to avoid extreme variations.

Until the erection of the plant described in this Paper, the Stratton district of the Cirencester Gas Company suffered severely from insufficient pressure during the Sunday cooking period. Although the pressure at the outlet of the Works' governor was raised to 12 in., the pressure at the extreme limits of that district fell to under 2 in. for short periods, and some consumers were unable to use their gas cookers.

On the plan of the Company's area it will be seen that the gas-works is situated on the south side of Cirencester, and Baunton and Stratton on the north side. Any extra pressure given from the works was to a large extent absorbed by Cirencester consumers, and when the pressure was increased to supply the outlying consumers, those near the works were troubled by large variations of pressure.

The villages of South Cerney and Siddington are not connected to the same distribution system, but are supplied through a separate main and governor and are free from pressure troubles.

The erection of a housing estate between Cirencester and Stratton brought matters to a head, and the following proposals to overcome the difficulty were considered:

(1) A 10-in. low-pressure main from a point near the works to Stratton, at a cost of £3,900.

(2) A 3-in. high-pressure main from the works to Stratton, *via* the outskirts of the town, which with compressing plant, building, &c., would cost £2,660.

(3) A gasholder of 30,000 cu.ft. capacity, erected at Stratton, with booster to fill the holder at night. The cost of this, with land and a building to house the booster, was estimated at £2,240.

(4) An automatic high-pressure compressing and storage plant with a storage capacity of 20,000 cu.ft., to cost £1,262.

After going very carefully into the matter it was decided to erect the latter.

I was very interested at the time in the high-pressure storage of gas on the district, and the South Suburban Gas Company very kindly allowed me to inspect a plant they had erected at Welling, where 72,000 cu.ft. of gas was stored at 60 lb. pressure in eight cylindrical containers. These were fixed on the floor of a disused gravel pit and were invisible from the road. The automatic compressing and governing arrangements were not suitable for our purpose, and a plant had to be designed to fit in with our scheme.

This was very efficiently carried out by Messrs. George Waller & Son, Ltd., of Stroud, who went to a great deal of trouble to provide a reliable plant, with proper safeguards against the failure of any of the components.

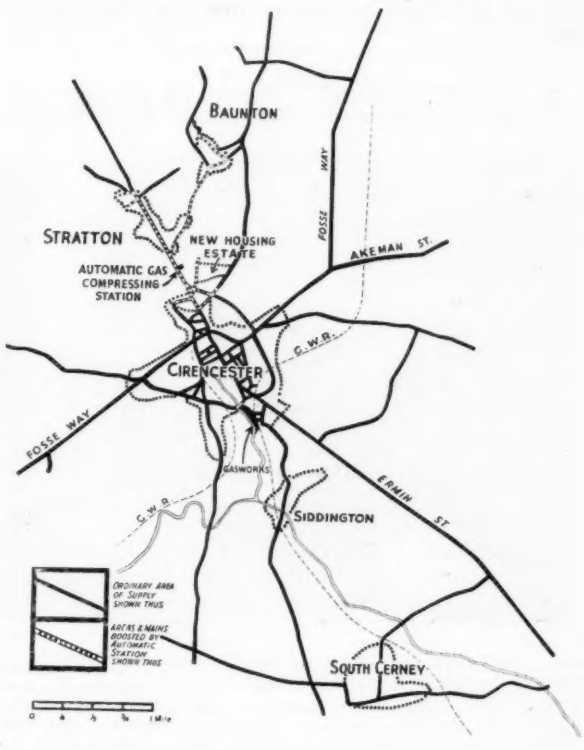
The plant was eventually erected on the best available site, and although I would have preferred a site half-a-mile nearer Baunton, experience has proved that the plant is quite satisfactory in its present position. As the building housing the compressing plant would be facing the main road from Cirencester to Cheltenham, it was decided to erect a stone building of good appearance. Although adding to the cost of the scheme, it was thought desirable that it should be consistent with the amenities of the district.

Description of Plant.

In general, the plant consists of a gas-engine driven compressor, two high-pressure gasholders, reducing governors, motor generator, batteries, switchgear, and all necessary equipment to make the station completely automatic.

Compressor.

The nominal capacity of the compressor is 2,000 cu.ft. per hour and it is designed to work up to a normal outlet pressure of 60 lb. per sq.in. It is a single cylinder, single acting compressor of the enclosed type, having a normal speed of 600 r.p.m. The inlet and outlet valves are of the Rogler spring plate type. They are fitted with removable nickel iron seatings and a handhole in the cylinder head enables them to be taken out easily. The cylinder, cylinder head, and valve chest are water cooled, the water being circulated by the thermo system. Forced lubrication is provided by a pump mounted on the crankshaft. The compressor is mounted on a cast-iron baseplate which is extended to take the engine as well. The engine and compressor are coupled by an automatic centrifugal clutch.

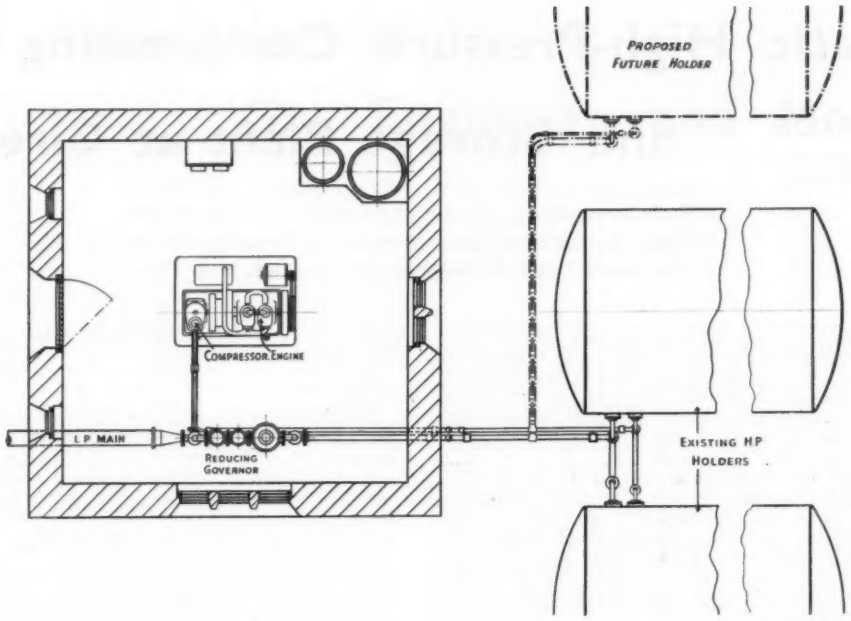


Engine.

The gas engine is a standard Lister vertical enclosed twin cylinder model, arranged for fully automatic working, and specially suitable for long periods of continuous running without attention. It develops 9 b.h.p. at 600 r.p.m. when running on town gas. It is fitted with dual magneto ignition, and forced lubrication from a sump in the crankcase.

As the district in which the plant is situated is residential, and as the plant is running at night, silent running is essential. In order to attain this, the exhaust is taken through a large expansion chamber in the compressor house before it is passed to a standard silencer, which is fixed in a pit outside the building.

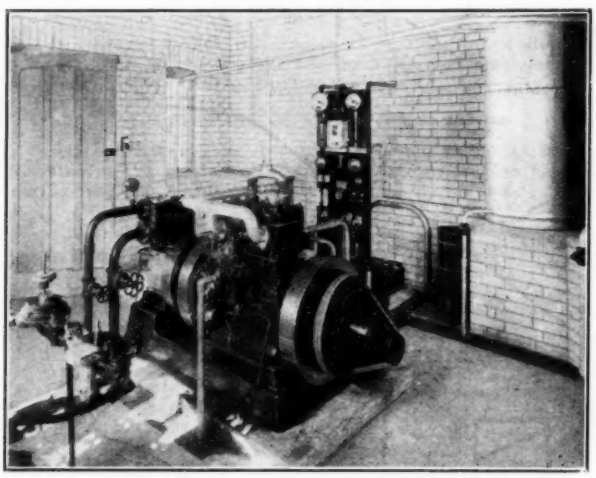
The engine also drives, through a twin V belt, a motor generator. This latter serves the dual purpose of charging the batteries and starting the engine. The batteries, in



addition to supplying the current to the starting motor, also supply current for the electrically-operated control gear.

Switch Gear.

The switchboard consists of three panels arranged vertically one above the other. The central panel comprises



the usual battery charging equipment—*i.e.*, volt and ampére meters, switches, shunt wound regulator, and fuses. Below this is a panel on which is mounted the automatic starter for the motor generator, and the solenoid-operated switches with timelags, which control the dual solenoid mounted on the side of the engine. One section of this solenoid opens and closes the engine gas valve, while the other operates the change-over movement from half to full compression.

The gas pressure control panel is fitted at the top of the switchboard, and on this is mounted a Venner timeswitch, a low-pressure diaphragm gauge with one adjustable electric contact, a high-pressure gauge with two adjustable electric contacts, and three relays which connect these three items with the automatic starter on the bottom panel.

Governor.

There is also fixed in the compressor house a 3-in. Reynolds district governor.

High-pressure Holders.

There are two cylindrical holders placed outside the building and space has been left for an additional holder. They are each 37 ft. long by 9 ft. diameter and are supported on reinforced concrete cradles fixed to a reinforced concrete foundation. The holders are constructed of $\frac{3}{8}$ in. mild steel plates riveted together, and were tested to a pressure of 90 lb. per sq.in. before delivery.

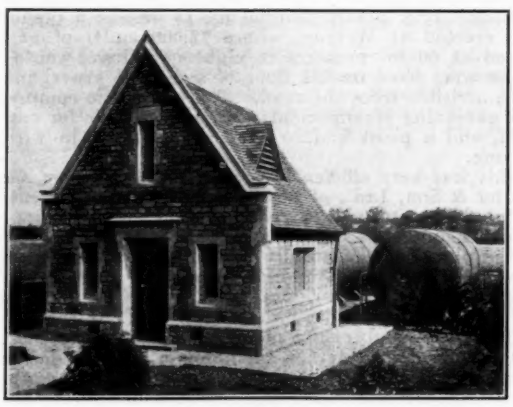
Automatic Operation.

The plant is entirely automatic in operation, and as it is intended to take gas from the district mains only during periods of low consumption, the Venner timeswitch is set to isolate the automatic starting gear from 6 a.m. to 11 p.m. This timeswitch can be readily set to prevent the compressor running during any given period, or any two periods, to suit the varying hours of heavy consumption.

When the plant starts up, the pull of the compressor causes a drop in pressure on the district main of from 5 to 7 tenths inch. As the compressor is only running when there is practically no load on the mains, a small reduction in pressure is allowable, but if during a working period any unusual demand, in addition to what the compressor is taking, causes the pressure to fall below 3 in., the plant is automatically stopped by the low-pressure gauge switch, which keeps the starting motor isolated until the pressure in the main has risen to over 3 in.

The high-pressure gauge switch, which is connected to the holders, has maximum and minimum electric contacts which are readily adjustable to suit any pressure. These are usually set at 60 lb. and 45 lb. respectively.

When the pressure in the holders drops to 45 lb. per sq.in. the minimum contact is made and the set is ready



to start up at the first working period, as set on the time switch. When released by the time-switch, the automatic switches close, opening the gas valve on the engine and holding the engine on half compression. At the same time the motor generator turns the engine over sharply and

starts it. The time lag on the solenoid is released and allows the engine to change over to full compression. As soon as the engine reaches 75% full speed the centrifugal clutch between the engine and compressor begins to engage, and the compressor very quickly picks up to full speed and is pumping into the holders.

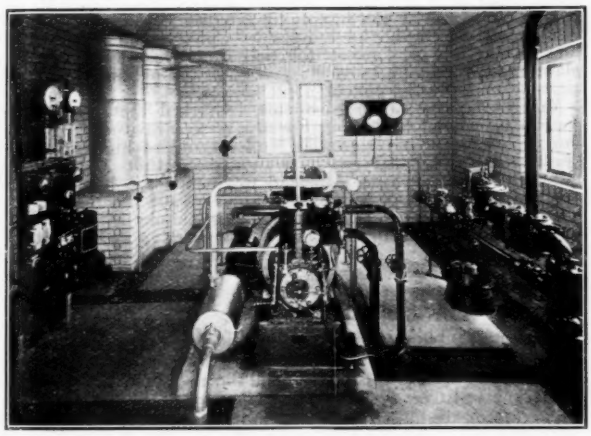
The motor generator also changes over from motoring to generating, and charges the storage batteries.

Should the engine fail to start, the starting motor can only run for one minute, when an emergency switch operates, and the motor is switched off, thus preventing the batteries from being exhausted. The gas valve on the engine is also shut off, and a red warning lamp, visible from outside the building, lights and remains so until switched off by hand when someone comes to attend to the plant.

When the pressure in the holders reaches 60 lb. per sq.in. the maximum contact on the high-pressure gauge switch releases the automatic gear. This shuts off the engine gas valve and stops the compressor. Should the engine for any reason fail to stop when the pressure reaches 60 lb., a spring loaded relief valve, set to open at 65 lb., is fitted to by-pass the gas back to the inlet side of the compressor. In addition, each holder is fitted with a spring loaded relief valve, set at 75 lb. per sq.in., as a final safety device.

In the pipe line between the outlet of the compressor and the holders, a special non-return valve is fitted to prevent any leakage back through the compressor valves. It also keeps the holder pressure from the compressor piston, so that it is not immediately against load when starting.

It will be noticed that the minimum contact on the high-pressure gauge is set at 45 lb. per sq.in., so that the plant is started up as soon as the pressure in the holders



falls to this level. This is to ensure that the holders shall not be exhausted by two consecutive discharge periods without filling up between the running periods.

The outlet of both holders is connected back to the district main through the Reynolds governor, which reduces the pressure down to 5 in. and maintains this pressure on the district. Only one main is necessary between the plant and the district main, and both the compressor and the governor are connected to this main. When the compressor is running, the pressure in this main drops to 4·3 in., and as the governor is set to open at 5 in., gas would circulate through the governor and back to the compressor unless the governor was automatically isolated during the compressing period. This is done by means of a cut-off valve fixed on the outlet of the governor, and operated by oil pressure from the lubricating pump on the compressor. The cut-off valve is therefore always shut and the governor out of action when the compressor is running.

To prevent any excessive pressure being thrown on the district in the event of the governor failing to close, a mercury seal is fitted on the outlet of the governor, immediately after the cut-off valve. This is set with a seal equivalent to 12 in. water gauge, and would blow gas away through a pipe leading to the outside of the building if the pressure exceeded this figure.

The high-pressure holders are fixed horizontally and with a slight fall, so that all condensation drains to one end and is passed into a syphon pot, from which it is blown periodically into drums, to avoid any unpleasant smell, and taken to the works. The condensate averages about 5 gallons per month from each holder, and consists of an emulsion of oil and water.

The gas distributed from the plant is a dry gas, and the calorific value is not appreciably affected by compressing up to 60 lb. per sq.in.

The total cost of the plant was £1,262, made up as follows:

	£
Engine house, including engine foundations and foundations for two holders, also including the sinking of a well	395
Automatic compressing plant complete, including two holders	787
Land	80
	£1,262

An additional high-pressure holder would bring the storage capacity up to 30,000 cu.ft. at an extra cost of under £200.

The plant has been in operation for over three years and has proved a very useful asset to our distribution system. On two occasions we have been able to shut off the works late at night, in order to carry out alterations to the trunk main, and the high-pressure holders have maintained the supply, for an hour or two about midnight, without any difficulty. On another occasion a mistake was made when changing over to a spare booster at the works, and the supply from the works was cut off for a few minutes until it was noticed that the pressure at the station governor had dropped to 3 in. The high-pressure station had come into action immediately the works was cut off and saved the district from a total failure of supply.

The capacity of a plant of this description is limited by the size of main at the site, and by the number of hours available for compressing. Apart from those limitations, it acts just the same as a high-pressure feeder main and makes use of the district mains at a time when they are idle.

In my opinion, it is a satisfactory solution to the problem of maintaining pressures in outlying areas, and in providing district storage in residential areas where a water-sealed holder would create opposition.

Discussion.

The PRESIDENT, in opening the discussion, remarked that the Paper would be of considerable interest to many of them who were suffering under the difficulties of housing schemes and ribbon development some distance from the gas-works.

Mr. G. DIXON (Nottingham) asked whether Mr. Cleator had noticed any difference in the unaccounted-for gas figure since he installed this system. Was he by compressing the gas losing anything in volume? Or was the amount lost in compression saved by an evening up of the pressure in the mains? He also enquired about the condensate removed from the holders.

Mr. CLEATOR observed that he could not see what effect this system would have upon the unaccounted-for gas figure. The high-pressure only existed in the storage cylinders, and if these were quite tight there could not be any loss. As a matter of fact, the unaccounted-for gas had dropped during the three years the plant had been in operation by 1½%. He thought this was due to the fact that previously they had a 12-in. pressure on Sundays, whereas they now maintained 8 to 9 in. The installation levelled up the pressure all over the district. As regards condensate, about 5 gallons were removed each month, the whole of this consisting of oil carried forward from the compressors.

Mr. G. M. GILL (London) observed that Mr. Cleator had referred to capital costs, but had not mentioned operating costs. He asked what proportion of the gas made was compressed into the cylinders. It had been stated that the capacity of the compressing plant was 2,000 cu.ft. per hour; but they could better picture what that meant if Mr. Cleator would give them the maximum daily and hourly outputs. He would also like to know whether during the three years this plant had been in operation there had been any mishaps and whether it had always functioned as it had been designed to do. It would be appreciated from Mr. Cleator's description that the plant appeared to be somewhat complicated by a number of automatic devices, and from this point of view he would like to know whether it had always functioned satisfactorily.

Running Costs.

Mr. CLEATOR gave the running costs per 1,000 cu.ft. of gas compressed over the last twelve months as follows:

	Per 1,000 Cu.Ft. d.
Gas used for engine	1·76
Oil for lubrication	0·21
Attendance	0·32
Repairs	0·44
Total	2·73

He had not mentioned depreciation because the plant only handled small quantities of gas; if he did allow for this item at the rate of 10% on the engine and holders, 5% on the building, and nothing on the land (which actually tended to appreciate) it would come to 7·47d./1,000 cu.ft. This sounded a high figure; but if they were to put in a high-pressure main the figure would be greater if they only passed that amount of gas through it. Moreover, with a high-pressure they would have to be pumping for five or six hours a day and would not know much gas was going out at the other end. With this high-pressure storage system gas was only passing out when it

was required The make per annum of the Cirencester Gas Company was 83 millions, of which only about 3,500,000 cu.ft. were compressed. The maximum daily output over the whole district was 360,000 cu.ft. and the maximum hourly output 45,000 cu.ft. The maximum daily quantity which the compressing plant was required to deal with, however, was only about 18,000 cu.ft.—which they reached on Christmas Day. There had been breakdowns, said Mr. Cleator; one was bound to have them with a plant of this description. The electrical equipment was always liable to break down—in fact, that was the only part of the whole plant which had failed; the gas part had been quite satisfactory. The greatest trouble had been due to the batteries. These functioned satisfactorily for about two and a half years, and then, six months ago, he had to renew four batteries. The trouble was due to incapacity to hold the charge, and if the gas engine was slow in starting there was not sufficient current to excite the solenoid and start the engine. Normally the plant worked perfectly, and it had been operating recently with the new batteries with no trouble whatever. It was only necessary for a man to visit the plant twice a week in order to pump the water from the well to the cooling tank. The lubricating oil was drained once a month, while the only other attention was the periodical decarbonizing and valve grinding of the engine. The plant was really not so complicated as it might appear.

Mr. F. Shewring (Stratford-on-Avon) remarked that he had had the pleasure of inspecting this plant on several occasions, and he could say that special care and foresight had been employed with a view to rendering it foolproof. The last paragraph in the Paper, he observed, struck the nail on the head—namely, the plant was a satisfactory solution to the problem of maintaining pressures in outlying areas, and in providing district storage in residential areas where a water-sealed holder would create opposition. Whether such a plant was suitable for any particular district only the engineer who was familiar with local circumstances could decide. In Mr. Cleator's case it had proved an excellent safety device when the gas supply to the holders had to be cut off. The installation had justified Mr. Cleator's choice, and he was to be congratulated upon its success.

Insurance.

Mr. T. H. Poulson (Stafford) expressed surprise at the figure for attendance; this worked out at only £5 per annum, which was very low indeed. He noticed that the cylinders were tested before delivery to 90 lb. pressure and that each was fitted with a spring loaded relief valve set at 75 lb. pressure. Mr. Poulson considered that the test pressure should exceed the blow-off pressure by a greater margin than 15 lb. He thought that the holders should be tested again after fixing, as there was always the likelihood of damage during transit—in which connection he could speak from experience of a case involving a boiler. It was not necessary to insure pressure gasholders under any Act of Parliament, and he would be glad if Mr. Cleator could inform him whether his holders were insured. He would be interested to know whether any expansion or movement was discernible in the holders and whether they were supported on rollers or otherwise enabled to expand freely without resistance longitudinally. Also, were they held down in their settings? It seemed to Mr. Poulson that the weight of the holders might cause sufficient adhesion between the holders and their cradles to create strain. In the event of a blockage occurring in the main on the supply side of the compressors, would there not be a risk of suction being created in the main with the compressor at work? This would result in flames being extinguished and air being drawn into the pipes—a dangerous state of affairs. In conclusion, Mr. Poulson pointed out that as the plant could only work during periods of lowest consumption Mr. Cleator could not supply gas for night loads, such as bakeries might require.

Mr. Cleator stated that they had to go to Parliament to obtain a special Act to enable them to store gas on this additional land. The whole plant was insured, including the holders. This was the first case of pressure holders that their insurance company had had, and they had raised the question of testing; they sent their Engineer down to test up to 90 lb. pressure, and the holders were found to be quite tight. Moreover, their examiner stated that it was unnecessary to examine them more than once every seven to ten years. The holders were bedded down in bitumen, but no rollers were installed, as it was not considered that there would be sufficient movement to make them necessary. Neither during frost nor on a hot summer's day was there any appreciable movement. The cut-off valve came after the governor and only operated when the compressor was running. If gas was passing out, the governor would shut off because the pressure at the outlet would be high enough to close the valve. But if the engine was running when a blockage occurred, then the automatic switch on the low-pressure side would shut off the engine; and it could not be set going again until there was sufficient pressure in the pipe to start it. The plant was, in fact, safeguarded in every possible way. As regards the supply of gas for night loads, Mr. Cleator observed that the compressor plant was running usually from midnight until about 5 or 6 o'clock—till the holders were full. If any trouble occurred in the supply during the night the pressure would drop on the low-pressure side, which would make a contact on the low-pressure switch and shut everything off. The plant could then only be re-started when the pressure was sufficient to operate the switch.

Mr. R. Halkett, Jnr. (Sheffield), remarked that Mr. Cleator was to be commended upon his progressive attitude in installing this type of plant; for an undertaking of his size it was very enterprising. He went on to explain that with a large industrial load, such as they had in Sheffield, a plant of this description could not possibly fill their requirements.

The President moved a hearty vote of thanks to Mr. Cleator for his Paper, which was carried unaimously, and the latter briefly responded.

The Importance of Factory Lighting

Address to the Illuminating Engineers

Factory lighting is a problem that at the present time very much concerns the Home Office, inasmuch as it so vitally affects accident prevention. It was then very opportune that Mr. E. W. Murray, H.M. Engineering Inspector of Factories (Home Office Industrial Museum), should have addressed a joint meeting of the Illuminating Engineering Society and Institution of Engineers-in-Charge on "Factory Lighting and Accident Prevention" at a Meeting of the Society at the Institution of Mechanical Engineers on Nov. 10.

There are many problems peculiar to factory lighting. Mr. Murray did not, therefore, deal with the more technical phases, but rather confined himself to the common-sense point of view, embracing methods which have been found in practice and have had to be altered to achieve the desired results; ideas which are being used with much benefit to the workers; and also to a forecast of what might be expected in the future.

After deploring the slowness of education as regards illumination, Mr. Murray went on to give a word of advice. It was very necessary to be sure of one's ground before putting any scheme for improved lighting forward. One should try to see the objects which the operatives were expected to see, and that under the worst of conditions. Another piece of sound advice concerned the need for the frequent cleaning of lighting fittings. "Soap and water," he said, "are cheaper than the energy to provide light." In the planning of any improved scheme it was necessary to copy as far as possible the qualities of natural lighting, particularly to avoid glare and patchiness or great contrast; so that the best lighting scheme that could be adopted was good general lighting.

Some idea of the inadequacy of the lighting in a large proportion of industrial establishments was shown on a chart in the Home Office Industrial Museum. This chart recorded monthly the reportable accidents in factories and workshops. The increase of accidents in winter, or the months when artificial lighting was necessary, was very noticeable—a large proportion of those accidents being due to people falling.

A glaring light was always a hindrance to vision, and unfortunately this was a very common fault in lighting installations. A glare from a light distracted from an otherwise adequate illumination level. In order that glare might be the more easily detected, it might roughly be defined as any brightness within the field of vision of such a character as to cause discomfort, annoyance, interference with vision, or eye fatigue. Regarding the qualities of artificial daylight, Mr. Murray said that a few years ago some enquiries were being made about lighting in weaving sheds, and in some instances the operators expressed a preference for gas. The reason for their choice was stated to be the whiter light that was obtainable with gas lighting, but Mr. Murray was inclined to the view that the heating value of gas lighting had something to do with the problem. In this connection he gave a slide showing a rather useful gas lighting fitting that could be adjusted to give more or less radiant heat as required.

In the course of the ensuing discussion, the President, Mr. A. Cunnington, called upon Mr. K. F. Sawyer, of the Gas Light and Coke Company, to give a few details of the lighting installation at his Company's new Laboratories at Fulham. With the aid of slides, Mr. Sawyer indicated the various points of interest which this installation presented. The maximum illumination provided was 17 foot-candles, and the average was 12 foot-candles. While calling attention to the provision of panel heaters fixed alongside some of the lighting fittings, Mr. Sawyer observed that a gas lighting system of from 15 to 20 foot-candles provided sufficient heat for the normal requirements of most workshops. This prompted a sound comment from the President, who said that it was indeed fortunate for the Gas Industry that the months of greatest darkness—*i.e.*, the shortest days, coincided with the months of greatest coldness. Mr. J. G. Clark, of the British Commercial Gas Association, also gave slides illustrating typical gas installations which clearly showed how suitable gas lighting is for the factory.

Does Gas Coke To-Day Satisfy all the Requirements of the Market?

A résumé of a debate at a meeting of the Coke Salesmen's Circle held at Gas Industry House, London, on Oct. 28, Mr. H. C. Smith (Chief Engineer of the Tottenham and District Gas Company) presiding.

Mr. J. GRAYSTON (Lea Bridge), proposing the case for the affirmative, observed that the prominence which of recent years had been attached, and not without cause, to the possibilities of coke as the fuel of the future had led all who were concerned with its production and marketing to ask whether the coke manufactured by the Gas Industry to-day met all the requirements of the market. Before anyone attempted to reach an opinion on this somewhat controversial question they were faced with an even more difficult question—namely, what were the requirements of the market? If they could satisfy themselves on the second question, the first one automatically answered itself.

He was loath to remind a gathering of coke salesmen of a rather unpalatable fact; but, as an engineer, he must point out that the gas undertaking was still its own best coke customer; 20% of the total coke made was required within the retort house, and until their coke sale development could bring about a fundamental change in the ratio between the net selling price of coke and the original cost of coal, the economics of the process would always enforce this state of affairs. For producer work they must have a coke of high reactivity, of an open and free structure, which would yield a good quality producer gas under slight draught and without the intense heat. There could be no gas, nor for that matter any coke, unless they heated their retorts sufficiently. Therefore, he made this a fundamental requirement in any coke. He knew that some of them would criticize this assertion on account of breeze-burning producers, Trefois producers, and so on; these were practical and successful, but he had still to learn of any works which had enough breeze to heat all its retorts all the year round—in fact, after steam raising there were many works without a surplus of breeze. Furthermore, the manufacture of water gas often absorbed up to 25% of the total coke production.

Of their outside markets, continued Mr. Grayston, the most important was purely industrial, involving the use of coke in direct-fired boilers either for steam raising, central heating, or the two combined; bakers' ovens and many industrial uses fell into this category. The requirements here were for high combustibility—that was, rate of reaction with oxygen—high calorific value, and freedom from troublesome clinker formation. He imagined that the critics of the present-day gas-works coke would base their objections on the grounds that it was not a coke which would burn in all and sundry existing domestic coal burning grates; in other words, that it was not sufficiently free burning and easy of ignition. No problem of combustion had been more fully explored than this, and on this subject there had been great diversity of opinion; various authorities had suggested volatile contents from 2% to 10%, and there was complete lack of unanimity on any characteristic. The Gas Industry offered a fuel of uniform properties which was the only absolute essential. They were satisfying the requirements of the market if they proceeded along the lines adopted by steamship companies in the early days of oil firing. They did not scrap existing coal burning vessels; they fitted conversion sets instead, while new vessels were equipped with apparatus to burn the most economical fuel in the most efficient way. This was exactly what they could do with gas coke for the domestic hearth; and gas coke, especially that produced in continuous vertical retorts, would never fail to do its job. Another feature of the domestic demand was the hot water installations, and they all wanted a boiler which would keep in all night.

Mr. Grayston maintained that present-day coke was not merely a compromise, but was actually an ideal combination of physical and chemical properties, quite capable of meeting those almost diametrically opposed demands, and he suggested that if any radical change was made in any characteristic in order to meet an individual market it would be to the detriment of all others. If carbonizing conditions were altered to give a coke which would burn in any old grate they would find that the entire contents of a domestic boiler using this coke would be consumed in three hours or thereabout. If they aimed to get a coke of very high reactivity for generator work it was entirely unsuitable for direct combustion, while a coke with high bulk density and slow burning properties, suitable for the small domestic boiler, was impossible for open hearth fires.

Other market requirements as to quality were uniformity, freedom from ash, clinker, and breeze, and freedom from superfluous moisture; all these the modern works was actually providing.

All considerations led Mr. Grayston to say that gas coke adequately met all present-day market requirements as to quantity. He did not wish them to conclude, however, that finality had been reached; markets and demands might change, and, if so, they might lead to change the characteristics of their coke.

There was one other market requirement which he approached with greater diffidence; it was the market requirement as to quantity. Up to the present he thought that Gas Industry had succeeded in coping with all its customers; but one could not be quite so optimistic about the future. This, however, made coke marketing more remunerative, and the higher the selling price the more coke there would be to sell outside and less used on the works. If only the selling price of coke could be sufficiently raised, Mr. Grayston observed that he could foresee an increase of more than 30% in the coke available for sale; and until all this was absorbed he thought they were still able to say that the Gas Industry was meeting all the requirements of the coke market.

The Salesman's Viewpoint.

Mr. J. H. PARKES (Brighton), in seconding the proposition, introduced by Mr. Grayston, remarked that he would like to make a few comments purely from a salesman's viewpoint. He, too, needed a fuel which would ignite readily, would burn steadily at a high temperature over a long period; would not contain too high a percentage of ash or moisture; and would be reasonably consistent in performance of its duties. A fuel suitable for use under many varying conditions and in a hundred different types of apparatus. He suggested to them that, speaking generally, gas coke did fulfil the conditions outlined by him—perhaps not in every detail every time, but, in the main, was quite satisfactory in its standard of efficiency.

Their steadily mounting sales, the new types of coke burning appliances which were continually being put on the market, were a certain indication of the trend of public opinion as to the value of their fuel. Incidentally, the very anxiety on the part of the manufacturer to market such apparatus was also indicative of his confidence in coke. While agreeing that the quality of their product was not the *only* factor in their advance, Mr. Parkes submitted that it was, and had been, the most important. If their standards had not been maintained, or were not being maintained, their progress in the solid fuel world would not have been so successful. Advertising had done its share admirably; but he would remind them that the best advertising in the world would not continually sell a fuel which did not do what its advertising claimed for it. This brought him to the first point he wished to make—that, generally speaking, coke as at present produced was of a satisfactory standard for the majority of uses to which it was put. His second point was that it was probably correct to assume that a substantial alteration in the type of gas coke as at present produced, though perhaps to the advantage of a particular user, would be generally detrimental. In Mr. Parkes' view, the position was that the Gas Industry seemed to have arrived at a sort of lowest common multiple in coke production, with a fuel which, considering its many uses, was most satisfactory generally, and therefore did meet the requirements of the market.

He asked them to dismiss from their minds the complaints that they were compelled to listen to. If they considered the numbers of coke users the percentage of customers complaining, even allowing for those who did not complain though perhaps entitled to do so, was very small. In any case, the majority of complaints in connection with coke burning, suggested Mr. Parkes, were not so much due to indifferent coke as to bad stoking, lack of knowledge of the apparatus being used, badly fitted appliances, or ignorance of the best means of obtaining the required results from the coke. He ought to include, also, often the shortcomings of the appliances themselves. Coke might be more difficult to stoke; but that was not the issue. His point was that, given correct use, it would be quite satisfactory, and thus no cause for complaint would arise. He would therefore ask them to give coke the credit due to it—and not to be unduly influenced by their old friend "complaints." He felt that their problem to-day was not so much to seek to improve the quality of coke, but to improve the quality of understanding of coke and its use.

A Manufactured Product.

Introducing the case for the "opposition," Mr. W. JOHNSON (Wandsworth) observed that he had prepared a reasoned argument that coke did meet all the requirements of the market; but, were he in a court of law, he would simply say that Mr. Grayston had proved his case for him. The seconder wanted them to forget all about complaints, but most of the members present on that occasion were salesmen and were not allowed to

do that. It was true that the percentage of complaints might be small, but they were not small enough. All complaints cost money, and that in itself should be avoided.

In the first place, Mr. Johnson wanted to know whether coke was to be regarded as a substitute for coal or as a maunfactured fuel. If it was a manufactured product then it should be an improvement on its raw material—viz., coal. It must be capable of doing all that could be done with coal in a more efficient manner. If coke was a substitute for coal, then Mr. Grayston was right—it did meet the needs of the market remarkably well for a mere substitute. Mr. Johnson's view, however, was that coke was a manufactured product within the meaning of his definition, and it must therefore be able to be used in all conditions where coal was at present employed and be more satisfactory. They would be deluding themselves if they believed that coke now fulfilled that standard. They needed a cleaner coke, one of uniform moisture content, and free from low-fusion point ash materials. It must be quenched in a manner which did not place the internal structure under stress and result in cracking and splintering. The texture must be one which gave the right burning properties. Mr. Johnson thought that these features could be obtained, although they might not be economic with their present skill and knowledge.

The question was how could they make coke a better product than coal. Mr. Grayston had already given them a few hints on that. In the first place, if they used clean coal they would obtain better coke. Then, coke picked up moisture when stored to a greater extent than coal. Bad quenching methods also increased the water content. They seemed generally agreed that clean coal was necessary for the production of good coke; but he did not think they could go further than express that opinion, because, after all, it was for the managements to decide whether to pay the extra cost of clean coal. They, as salesmen, considered that such additional expenditure would be justified.

As regards moisture content of coke, Mr. Johnson considered that the ideal would, of course, be to deliver the fuel at no more than its inherent moisture content. To deliver it with only a little more would be a very great achievement—and a great deal had been done in that direction. But the practice of taking the coke red-hot from the retort and plunging it into a pond was still very common; this increased the moisture content very considerably and ruined it for the open fire by reason of the fact that quenching the coke at that temperature set up a condition of stress inside the pieces of coke due to rapid cooling of the face. When this coke was put on the open fire and the heat expanded the pieces, the internal portions, being under stress, expand violently, resulting in crackling and splintering when burning. Shale was also a common offender in that respect. Therefore, when they could supply coke which was both dry and clean they would have gone a long way towards meeting the requirements of the market. Screening coke in a wet state was also responsible for dirt being carried into the screened fuel and being finally delivered to the consumer.

Again, he considered that in carbonizing coals the charge in the retort should be quiescent during the period of carbonization. The best method of carbonizing in order to produce good coke, he thought, was some form of intermittent system. Also, the quality of the coke could be greatly improved by blending of the coals. The economics of blending must rest with the engineer, but a great deal could be done towards better coke by blending clean coal and by the right method of carbonization. Clinker was a common complaint, as they all knew, and one way of overcoming this difficuty, especially in steam-raising plant, was to tell the consumer that he was overloading his boiler. This was a very bad way of trying to sell coke. Until they did something to investigate ash more thoroughly, he did not see that they could overcome the clinker difficulty.

The seconder was rather proud of the open fire, went on Mr. Johnson; he personally was not. Admittedly, as a coke-burning appliance it was very good; but he could not forget that for every coke grate that was installed, there was a tremendously greater number of coal grates being put in. The product of low-temperature carbonization could be burnt satisfactorily in any open grate, but he did not think it necessary for gas undertakings to have to carbonize at 500° in order to produce such a fuel. At the same time he was definitely of the opinion that the field for low-temperature carbonization should be within the Gas Industry and not outside it. He was convinced that a fuel which could be burnt in any open grate was capable of production at a gas-works—particularly in intermittent verticals.

Mr. Johnson, in conclusion, observed that he had said enough to justify his contention that coke did not fill all the requirements of the market. He pleaded for greater research to make coke a manufactured fuel and not the substitute which it was so often regarded. Coke should be a better product, worthy of a higher price.

Undesirable Characteristics.

Mr. J. C. Drewe (Manager, Coke Sales Department of the Plymouth and Stonehouse Gas Light and Coke Company), in seconding Mr. Johnson, based his argument on the following undesirable characteristics of present-day coke:

(1) High ash content.
(2) High moisture content.
(3) Low bulk density.
(4) Difficulty of ignition.
(5) Poor physical characteristics.

Some of these were more important than others and some had been partially overcome, such as high moisture. Again, certain of these characteristics were more important in the domestic market.

The question was, "How far did the coke manufactured by the Gas Industry of to-day fall short of market requirements?" This could best be illustrated by reference to the points that *limited* the use of coke in present-day markets.

On account of the undesirable characteristics that he had just mentioned, said Mr. Drewe, coke could not be burnt in appliances made for other fuels. They had first to install special appliances such as the coke grates before they could guarantee the efficiency offered by competitive fuels; hence with this condition to be overcome, they, as salesmen, were not only placed with the burden of selling two articles in order to dispose of one, but the demand and progress was retarded, since they must first design their appliance to create that demand.

At present in the domestic market, a special grate had to be installed. They could not ignite their coke with ease—it meant 15 or 20 minutes with the aid of a gas burner to light an open coke fire. Coke tended to create a good deal of dust, which was an important consideration when used in the home. In his opinion coke would never be able to fulfil the requirements of the domestic market until they could burn it in the coal grate.

Flexibility.

Coke of to-day, went on Mr. Drewe, should be far more flexible to meet the demands of the market. For example, in the open grate they had to keep a large fire well banked up to a depth of not less than 6 in. at the back in order to obtain satisfactory results both in regard to appearance and efficiency. Very little control was possible; hence the small room suffered from overheating with no alternative except at the expense of appearance and general efficiency of the coke fire in question.

There were many other disadvantages that were significant in the marketing facilities of present-day coke. These could best be defined under the general heading of physical characteristics, and had an important influence on its scope of utilization. Coke must be strong enough to resist transportation and not reduce its potential value by the production of breeze.

The question of bulk density was emphasized again, since its influence had a considerable bearing on distribution, carriage, and storage. Coke must be made more concentrated than it was to-day to compete with other fuels; they must all have experienced the difficultics of insufficient storage space being available in the modern average house. The space now made available was not large enough to enable the householder to put in a sufficient supply of coke without consistent deliveries on the part of the supplier, thus causing a high figure for overhead delivery charges.

He had pointed out the deficiencies of present-day coke, and in conclusion he would like to present his suggestions to render it a more useful fuel to the market. These were:

Decrease ash and moisture content.
Increase bulk density.
Increase ease of ignition.
Improve the physical characteristics.

Twenty Years' Progress.

In the course of the general discussion which followed, Mr. W. L. Boon (General Manager of the L.C.C.A.) observed that he had a great deal of sympathy with Mr. Grayston, though in his official capacity he had to agree with the other side. Twenty years ago coke was a product of poor quality and difficult to sell. But since that time they had brought it, without foregoing any of its benefits in respect to gas production—even, perhaps, increasing its advantages—to the product they were marketing to-day. They were on an ascending market where improvement could be continually expected. At the moment they were selling coke more rapidly than they could produce it, and the question to-day was not so much one of selling as of producing. In twenty years they had achieved a quality of coke which had put them in the position of not being able to make enough of it to fulfil the demand.

In regard to storage accommodation, went on Mr. Boon, they were doing all they could to improve the position. The L.C.C.A. was in touch with architects, builders, and public authorities. They had produced plans whereby present conditions could be improved; but he was afraid they could never look forward to the same facilities for fuel storage as existed years ago, when houses all had adequate cellars. They had visualized flats with but 5 cwt. storage space.

After one or two further speakers had contributed to the discussion, the original proposers and seconders of the resolution wound up their respective cases, and the Chairman brought the debate to a close. In doing so, Mr. Smith remarked that he was interested in the suggestion that the gas-works was their best customer. He reflected that when there was a shortage of coke and undertakings had to purchase supplies from outside, they generally utilized the outside coke on the works and released their own for the district. As regards complaints, he thought they must look at this matter from the viewpoint of the total number of complaints apart from the percentage. After all, an undertaking might say that it had only twenty complaints; but that might represent a 100% increase on the previous year's figure.

It was interesting, went on the Chairman, to hear the suggestion that coke was a primary product and not a by-product of gas. He did not think anyone could imagine this argument being put forward ten years ago; and he thought one could

appreciate from this how they had advanced in the production of this fuel. In his own Company their coals were purchased with a view to their coke-making properties just as much as from their gas-making qualities, and he thought he was right in saying that there was not a single class of coal they were carbonizing to-day which they were carbonizing ten years ago. They had all been changed with a view to improved coke production. A great deal could be done by proper selection of coals, and he hoped that in the re-organization of the coal industry they would still be able to purchase the coals they knew to be requisite for their coke production and not be compelled to take unsuitable material. Though they were supplying a satisfactory market to-day, they must look to the future. It would not always be so easy to retain, and they could not afford to rest upon their oars and do nothing. They must always be ready to meet keener competition in the future.

The Chairman observed that he did not think it would be fair to put this resolution to a vote. In any case it was not a question which could be answered by a plain "Yes" or "No." All they could do was to propose a very hearty vote of thanks to the proposers and seconders, and without making any invidious distinctions they might, perhaps, accord a little extra applause to Mr. Grayston and Mr. Parkes for coming there that afternoon to support a proposition which must be contrary to their own convictions in order to promote the excellent discussion they had had.

The meeting then terminated with a hearty vote of thanks to the Chairman for his presence on that occasion.

SYMPOSIUM ON

The Production and Utilization of Domestic Coke

A Joint Meeting of the North-Western Section of the Institute of Fuel and the Manchester District Association of Gas Engineers was held on Nov. 18 at Manchester, when a discussion was opened by Mr. A. Marsh, M.Sc., General Secretary of the National Smoke Abatement Society. We publish below the contributions of Prof. J. W. Cobb and Mr. H. J. Hodsman and Mr. E. W. L. Nicol.

The Relation between the Properties of Cokes and their Behaviour in the Domestic Grate

By Prof. J. W. Cobb and H. J. Hodsman

Prof. COBB: The following contribution is made as requested with the idea of giving some account of the work on this subject of domestic coke which has been carried out in the Department of Coal Gas and Fuel Industries in the University of Leeds.

The systematic study of coke during the last 15 years made in order to determine its suitability for use in the domestic grate, or other appliances, has resolved itself largely into an attempt to give quantitative expression to qualities which observations on coke in use had shown to be of importance. Without such quantitative expression it was impossible to compare and record satisfactorily the observations made on the behaviour of different fuels at different times and places, a necessary preliminary to their useful application. It was found, for example, in work carried out by S. Pexton[1] that the rates of gasification of cokes prepared at the same temperature from different coals, or at different temperatures from one coal, were not at all the same, and the rates of gasification in steam were quite different from those in CO_2. This was emphasized when a systematic examination was made, commenced by C. B. Marson,[2] of the influence in stimulating gasification of certain additions, such as soda, lime, and ferric oxide, to the coal before carbonization, or to the coke itself. It was plainly necessary to find some test quantitatively expressing these differences, and so a determination of reactivity was instituted in which the graded coke was gasified, under fixed conditions as regards weight of coke, velocity of gas stream and temperature, in CO_2 or steam, and the rate of gasification at any time noted from the extent of decomposition observed. Any such rate of decomposition must, of course, depend upon the extent of surface exposed, and the nature of the surface at any time, but rather to our surprise at the time, we experienced little difficulty in obtaining consistent results from the cokes tested. In any experiment a curve could be drawn showing any change occurring in the rate of decomposition as the gasification proceeded, and the use of this curve was a great advantage. Thus, it was made evident that in some cases the surface of the coke particles initially exposed was less reactive to CO_2 (as by graphitization) than the material below it which was gasified later. This established the necessity which exists for so carrying out the test that an appreciable fraction of the total material was gasified. That being done, however, a useful figure could be obtained representing the behaviour of the coke. The actual behaviour of many cokes in such circumstances showed that although the weight of coke during a test was diminishing, the effective surface seemed to remain substantially constant, as indicated by the constancy of the percentage of CO_2 decomposed to CO. The determination of this reactivity as a fundamental factor in the behaviour of the coke was so plainly serviceable, that the experimental method, as tried by W. R. Branson[3] was further standardized in detail by A. Key,[4] and a simple means was devised for giving numerical expression for the reactivity of the material, which has proved of great service. The determination is usually made at 900° C. for CO_2 and at 1,000° C. for steam, a convenient temperature of determination in each case. In the use of coke, these temperatures are often exceeded, and the question has often been raised as to how high the temperature would have to be before a point was reached at which the rate of gasification was not determined by the reactivity of the coke, but by the rate of supply of the gasifying medium, the reactivity then becoming of no effect. That question was investigated by T. H. Blakeley[5] by experiments in which it was shown with four fuels, differing widely in reactivity, that the effect of this difference disappeared only when the time of contact (with CO_2) exceeded 1 second at 1,250° C. or $\frac{1}{10}$ second at 1,550° C. In the domestic fire, the appearance and in some circumstances the radiating power are vitally affected by the rate at which the cold coke pieces added in a charge become effective radiators, by the rise in temperature of the surface. Here the reactivity at temperatures well below those of the normal test comes into play, and C. B. Bolland[6] worked successfully on a method by which comparative reactivities to air could be simply determined. The first signs of this reactivity to air can, however, be most conveniently detected by a thermal method for the determination of the so-called ignition point.[14]

Such determinations as have been detailed above are important properties of the coke material, but they exclude deliberately the operation of an important factor, coke size, in influencing the behaviour of the coke on a domestic fire, nor can they take into account other factors which operate in that connection, such as the influence of the quantity and nature of the ash on gasification and radiation. Moreover, the behaviour of the coke is not determined solely by its intrinsic qualities, but also by the construction and mode of operation of the fire in which it is used. These matters have received special attention from H. J. Hodsman and collaborators.

Design of Coke Grates.

Mr. H. J. HODSMAN: Modern fashion in the design of open grates can be traced to the efforts of Dr. Pridgin Teale, of Leeds, in his day a prominent eye surgeon and

pioneer in the improvement of public hygiene. He made a number of suggestions for increasing the efficiency of open grates, the design of which during the last century was at a low ebb. Some of his proposals were good and resulted in marked improvements. In one respect, however, the consequences were unfortunate. He advocated the shallow barless grate which eventually became standard practice. Teale's work was empirical and he probably ascribed to the form of the grate advantages which were really due to other features. Teale's grates were suited for the combustion of a narrow range of fuel, as he himself realized. Quite definitely he limited his claims for efficiency to the use of "good Yorkshire coal." From figures given, this implied a fuel containing 2·5% of ash. This limitation did not matter so long as interest in smoke abatement was small, but it prepared the most formidable difficulties for those wishing to popularize carbonized fuel with a low content of volatile matter. Difficulty in using high-temperature coke shrinks when the vertical height of the fuel bed is increased. The realization of this in the design of coke-burning grates and the incorporation of a gas burner for ignition has been followed by a rapid increase in the use of high-temperature cokes. This marks the dropping of the shallow grate advocated by Teale.

The factors determining the performance of a fuel are both chemical and physical. Considering the chemical factors first, we are concerned with the reaction of carbon with oxygen and carbon with carbon dioxide. Cokes differ widely in their reactivity towards oxygen at low temperatures, and this influences their ignitability. Generally speaking, this reactivity towards oxygen is greater as the "rank" of the parent coal falls, and also as the temperature of carbonization is reduced. Physical factors may modify this influence.

It was shown experimentally by Dent and Cobb[7] that at higher temperatures the differences in reactivity towards oxygen diminish and above a red heat disappear. Above 800°—so far as common fuels are concerned—the rate of combustion is determined not by the nature of the carbon but by the rate of oxygen supply. The practical significance is that, provided the fuel bed is hot, the differences in the "combustibility" of cokes are without significance when a fire is actively burning.

Chemically, the process of combustion of coke on the open grate resembles that in other fuel beds. Near the grate of a fire in active combustion the oxygen in the air disappears and the atmosphere in the fuel bed above the grate contains 18 to 19% of CO_2. Higher up, this is reduced more or less to CO according to the reactivity of the fuel to CO_2. If this is high, a considerable part of the CO_2 reacts with carbon to form CO which burns above the fuel bed in the blue flames. The reactivity of the fuel to CO_2 therefore determines what proportion of the heat of combustion of the fixed carbon shall be generated in, and what proportion above the fuel bed by combustion of CO. The latter part is less effective as a source of radiation and accordingly the greater the reactivity to CO_2, the smaller will be the output of radiation per unit of fuel.

Reactivity to CO_2 is not, broadly speaking, a measure of ease of ignition. Ignitability of cokes is not dependent on chemical reactivity to oxygen alone. Physical conditions also play their part, other things being equal. A low density is also conducive to ease of ignition. Easy ignition may be found in fuels which are unreactive judged by chemical tests, and *vice versa*. This is exemplified by the behaviour of the cinders left on the extinction of a fire.[11] They are usually more ignitable than the original coke, and those who make intelligent use of this fact can obtain good service from fuels which are not very promising judged by chemical tests.

The ignitability of a coke can be increased by partial gasification in a current of steam.[12] Unfortunately, this effect is concentrated on the surface of the coke which becomes fragile and unsuited to handling and transport. Otherwise this would be a convenient means for activating high-temperature coke. Of course, in the case of unburnt cinders which need not be moved this difficulty does not arise, for a fire on extinction leaves a supply of activated fuel ready for use when required. Even the uninstructed consumer has come to realize this, as evidenced by the rapid increase in the installation of grates designed to burn coke. Moreover, the provision of a burner for lighting diminishes the need for emphasis on ignitability.

Performance.

The factors determining the performance of a fuel naturally call for consideration. Thermal efficiency alone does not weigh much with the consumer who has no means of assessing it. Nevertheless the effectiveness of different solid fuels varies considerably and the cost of the effective unit of heat delivered is important to users with limited purchasing power.

The rate of radiation depends in the first place on the size and form of the grate. The shallow, barless grate is in this respect at a disadvantage. If a given fuel is consumed in a shallow and a tall fuel bed, it will be found that the latter gives the higher efficiency. (Bligh and Hodsman,[9] Milner, Dyde, and Hodsman,[10] Fishenden.)

The rate of radiation is also dependent on the shape of the fuel.[10 11] Rate of radiation depends on the area of the radiating source, and on the fourth power of its absolute temperature. Clearly, therefore, the areas at the highest temperatures are the most important contributors. Other things being equal, a fuel which in burning develops large glowing unscreened cavities will be most effective. Such fuels are those of light, open irregular angular form which pack loosely in the fuel bed. On the other hand, dense fuels of regular geometrical form which pack closely are less effective.

There is no obvious simple way of measuring the effective areas of high-temperature radiation, but they are certainly connected with the relative bulkiness of a fuel. For this reason we have taken the bulk density of a fuel as a measure of this property, and all our experience confirms the view that bulky fuels are the more effective radiators. Unfortunately, high density is desirable from the point of view of ease of storage, transport, and for use in closed stoves. Some of the desirable properties of a fuel are mutually incompatible and compromise is inevitable.

So far as chemical composition goes, the most effective source of radiation is the combustion of the fixed carbon of the fuel. In so far as the heat of combustion is developed by the burning of volatile matter above the fuel bed, there will be a falling away of output of radiation. This is the reason for the low thermal efficiency of coal as compared with cokes, and also why high-temperature cokes are thermally more effective than low-temperature cokes. The value of the flickering flame is æsthetic rather than thermal.

If the fuel is reactive to CO_2, then some of the carbon in the fuel bed is converted to CO, which burns above the fuel bed in a somewhat ineffective manner. Activation of the fuel by means of soda involves some reduction in thermal efficiency, as a set-off against advantages in other directions.

In considering performance, one should distinguish between rate of radiation and total output of radiation. An intense radiation may be obtained at the cost of rapid consumption. Hence the desirability of making complete efficiency tests if a comprehensive picture of the properties of a fuel is to be obtained.

Ash.

The quantity and kind of ash may weigh more with some consumers than efficiency or price, and it is surprising that so little attention has been given to this. A light ash which clings to the surface of the fuel obstructs radiation, and as it accumulates, it chokes the fire and lowers the rate of combustion. Thus it may impair both thermal efficiency and output, while its tendency to drift about the room is objectionable. Some attempt should be made to give the ash content of a fuel on the volume rather than the weight basis. It is not easy to devise a satisfactory simple bench test for this purpose, but one should be sought. The test of ash volume which we employ is simple,[11] but the results are influenced by the manner of preparing the sample.[13] A more elaborate test is used at the South Metropolitan Gas Company,[15] to which the same objection may apply.

Taking all these factors into account, it appears that fuels should not be judged solely by single chemical tests on small particles. If a single test is to be employed, it should be one of performance in the grate.

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Contribution

By E. W. L. Nicol, Assoc.I.C.E., A.M.I.E.E., M.Inst.Mar.E., F.Inst.Fuel,

Technical Adviser to the London and Counties Coke Association

This meeting is devoted primarily to the consideration of coke for use in domestic open grates, in relation to smoke abatement but for various reasons, which I shall endeavour briefly to explain, consideration of this subject cannot altogether be dissociated from the question of using the same fuel for other domestic and also industrial heating purposes.

The mitigation of domestic coal smoke pollution involves the manufacture of smokeless fuels on a large scale, by means of partial or complete carbonization of coal, as carried on in the Gas Industry. It is the solid-fuel product of the latter process that I propose to deal with—namely, high-temperature gas coke, sized or graded for domestic heating purposes.

The economic factors and other problems involved in the manufacture of smokeless fuels in adequate quantities are both numerous and complicated. These include the disposal of the liquid and chemical products of the process at remunerative prices, and the maintenance of a balance in the demand for the gaseous and solid fuel products. So long as that balance is maintained, there is no practical or economic limit to the development and expansion of the Gas Industry; and there is no apparent reason why that balance should not be maintained in the future, as it has been in the immediate past. Although not many years ago the demand was enormously out of balance in favour of gas, organized effort directed on scientific lines, has more than turned the balance in coke's favour, with financial and practical results which will be of permanent benefit to the Industry.

Domestic or household solid fuel is a commodity subject to seasonal variations in demand, ranging in many cases from almost zero to the winter maximum. This is especially true of open grate fuels, their use in many districts being almost entirely discontinued during the summer months; so that in order to maintain a manufacturing plant in continuous and economic production the solid smokeless fuel produced must be capable of storage without serious loss, and equally suitable and economical for domestic use and industrial processes not subject to seasonal variation. That is one reason why the present question of domestic coke cannot adequately be discussed without due regard for industrial and non-seasonal uses. For these latter purposes the fuel must be sold in competition with relatively cheap descriptions of industrial coal. Adequate stocks must be accumulated in summer to meet the combined maximum winter demand. This consideration involves also a market for the smalls inevitably produced in double handling, cutting, screening, and grading. Another reason is the lack of sufficient fuel and accommodation in most houses and producers' and merchants' premises, to allow for storage and the segregation of different sizes of fuel for different purposes.

Gas supply authorities are by far the largest manufacturers of smokeless domestic fuels. In addition to the use of large quantities of gas oil, the gas coal carbonized annually at gas-works amounts to approximately 17 million tons, producing for sale, in addition to gas, which is also a smokeless fuel, about 7·5 million tons of gas coke, which in recent years has found a ready and growing market as fuel for industrial, open and closed fire, domestic and quasi-domestic heating purposes, at relatively cheap prices. Surplus gas coke has also been exported to Scandinavian countries, where its economic and hygienic merits are fully appreciated, indicating that, as at present produced, good gas coke satisfies all reasonable requirements; but I do not suggest that improvement generally is not possible.

A Clear Conception.

In order that the subject of domestic coke may be fully appreciated, a clear conception of all actual and potential domestic fuel requirements is necessary. These requirements naturally vary considerably in different parts of the country and in different communities, and as the restricting influence of the obsolete heating appliance tends to disappear. They include not only open fire heating, but also cooking, central heating and hot water supply, as well as lighting and refrigeration. Each and all of these heating purposes must be taken into account if the public are to be adequately served with smokeless fuels produced on a commercial and economic basis at a reasonable cost, from the one available source—namely, bituminous coal.

In whole districts of the country, and especially in the North, a single open fire often serves also for cooking and hot water supply, in addition to heating. No smokeless solid fuel is altogether suitable for these three primary heating purposes, which are necessarily intermittent and require flaming and non-flaming characteristics. These characteristics are simply incompatible in any one solid smokeless fuel, and the sooner that fact is recognized the better it will be for improvement and progress in domestic smoke abatement. In the warmer climates of the South the tendency in recent years has been to install separate appliances for cooking, heating, central heating, and hot water supply. Combined domestic coke-fired central heating and hot water supply boilers are now installed in large numbers. These serve also as refuse incinerators, which is an important domestic heat service and that must not be ignored. That there are wisdom, economy, comfort, and convenience in this tendency, as well as hygiene, no one will deny. In the manufacture of the gas used for lighting, cooking, refrigeration, occasional heating, and hot water supply, the coke which is necessary for continuous heating and open fires is also produced.

Economy in the widest nationally economic sense is realized in adopting this single-purpose appliance system of cooking, heating and hot water supply, since the use of bituminous coal directly as fuel may be eliminated and the chemical and other by-products recovered for use in agriculture and many other indispensable industries, as well as the defence of the Empire.

Domestic cooking operations and the demand for hot water for baths, &c., seldom synchronize; open fire and central heating is largely seasonal, but the need for hot water is continuous and non-seasonal. The various daily heat requirements are essentially intermittent and incompatible, but they may be conveniently and economically reconciled by the use of separate appliances. No single fuel can economically fulfil all modern domestic heating requirements, which are not only intermittent and continuous but also seasonal and non-seasonal. In my submission, gas and gas coke fulfil all the required conditions, including smokeless combustion and national economy—gas for cooking, occasional heating and hot water supply; gas coke for open fires and central heating in winter and continuous hot water supply.

The key factor in the development of smokeless domestic heating appears to be coke. Coke is the most valuable secondary product in the production of gas on a large scale. The future of gas depends mainly upon its relative cheapness, and the cheapness of gas depends more upon an adequate and remunerative non-seasonal market for coke than upon anything else. The most remunerative and natural market for coke is the domestic market, as a relatively cheap auxiliary and complementary fuel for continuous heating but, at least at present, the industrial market is also essential to continuous demand.

The design, or lack of design, renders the ordinary open coal grate unsuitable for use with gas coke as fuel. The abnormally restricted fire grate obstructs the draught which is necessary for the free and active combustion of coke, and the resulting dull and unattractive fire naturally leads to prejudice against coke as an open grate fuel. Difficulty of primary ignition by ordinary means is also inherent in gas coke, and it has taken many years of labour to break down this prejudice and to overcome the ignition problem. That these difficulties have been overcome satisfactorily is perhaps the most important achievement in the cause of domestic smoke abatement that has been accomplished.

There is nothing inherently special about a coke-burning grate—it is merely normal, and perhaps the most convenient open fire. The one essential feature is simply a bottom grating spaced to release the ash automatically. By means of a gas ignition burner the momentary reunion of the two fuels, separated at the gas-works, ensures positive ignition of ordinary gas coke with greater convenience and less labour than an ordinary coal fire. Used in any of the open grates of this description, of which there are several now available, suitably graded gas coke makes a fire of unusual charm and attractiveness, lasting and economical, and, of course, absolutely smokeless. A coke grate, moreover, does not preclude the use of coal, and a gas ignition burner would be an acquisition to any coal grate, and would tend materially to promote the smokeless combustion of coal. The extent to which gas coke has been adopted as an open grate fuel since the introduction, only a few years ago, of the gas-ignited open coke grate is remarkable. With snowball effect, every one installed promotes the sale of others by personal recommendation. The total yearly sale has reached more than 70,000. The seasonal coke consumption of each grate installed is about two tons.

Similarly, closed-fire independent hot water boilers, suitable for use with coke of the same description and often the same grade, are now installed at a rate which has been estimated at more than 150,000 a year. The average yearly consumption of each is about three tons. From these figures the potential annual increment in demand for graded gas coke may be calculated.

The Oriental Gas Company

The Ordinary General Meeting was held at the Company's Office, Finsbury House, Blomfield Street, London, on Thursday, Nov. 19. The chair was taken by the Chairman, Mr. B. W. ELLIS.

The SECRETARY, Mr. S. Rainer, read the Notice convening the Meeting and also the Auditors' Report.

The CHAIRMAN, before moving the adoption of the Report and Accounts, said: I am sure you would like me to express our pleasure at the return of Mr. Stanley H. Jones among us after his long illness. A few months ago the Board decided to elect me as Chairman for the unexpired portion of Mr. Jones's year of office. This was done with his entire approval, and it is in that capacity I address you to-day. You have all doubtless studied the accounts and noted with satisfaction the increase in sale of gas of 1·68%. This is entirely due to the efforts of our staff in the face of difficulties, and to this I will refer later. And now, if you will turn to the accounts you will see the Capital Account remains unchanged on both sides, such expenditure as has been incurred having been charged to Revenue. In this, Coal is up by £182 as 2,841 tons more were carbonized. Salaries down by £907 owing to re-arrangements made on the retirement of Mr. Garsed, whom I am very glad to see with us to-day. Carbonizing Wages and Purification both show slight decrease as does also the item Repairs and Maintenance of Works, &c. Manufacture over all shows a decrease of £2,426. Distribution Account and Salaries of Officers is lower by £2,330. Our Superintendent, Mr. Morrison, retired and re-arrangement also took place here. But in addition to this an alteration has been made in our bookkeeping. Clerical Wages, instead of being charged under this head, are debited respectively to Mains and Services, Meters, and Fittings. In spite of this there has been a drop of £441 in Mains and £134 in Meters renewals, and it is only in Fittings and Stoves that an increase of £1,759 is shown, partly due to heavier depreciation. Distribution over all is down by £1,146 although £2,885 Capital expenditure on New Mains has been included in this. Public Lamps shows little change, being £38 up. Rents, Rates, and Taxes are lower by £1,387, this being accounted for by the welcome reduction in surcharge of Indian income-tax. In connection with this you will be pleased to know that our Manager has appealed with success against the proposed increase in our Rating Assessment.

Management.

Directors and Auditors are higher by £25 10s. 6d. and £22 4s. 9d. respectively by reason of higher income-tax. The Auditors in Calcutta also received an increase in Fees for additional work. Secretary and Staff up by £34 due to increment and tax. Clerical Salaries in Calcutta are lower by £616 due to the allocation of part of this to the other headings already referred to. Stationery and Printing is £9 lower and General Expenses is £177 lower. Management all over is less by £720. Bad Debts is £88 less and Law Charges remains practically the same. Superannuations and Pensions are higher by £2,199, which is more than accounted for by Mr. Garsed's gratuity on retirement. Gratuities to Workmen is an entirely new item to which I will refer later. Passages are up £256. This item always varies according to staff leave. Insurances are unchanged. All over the Revenue expenditure is lower by £2,149.

Coming to the Receipts side, Gas Rental is higher by £1,143, having sold over 589 million cu.ft. as against 579 million cu.ft. in the preceding year. Rental of Meters and Stoves is £74 lower, Meters being higher and Stoves lower. These may suffer a further fall in the current year as we have thought it prudent to make a reduction in rates. Coke and breeze are higher by £1,127 as we sold 1,634 tons more at a fractionally higher price, which price I would say, however, is less than one-third the price in this country. Receipts for tar were down by £262 in spite of having sold 87,000 gallons more than in 1934-35. We are helpless in this, being forced to produce tar in a highly competitive market as I said a year ago, and we do not see any improvement in sight at this date. Rents and transfer fees are both slightly lower. The total receipts are up by £1,889 and Expenditure down by £2,149, resulting in an increase in Trading Profit of £4,038.

Now if you will turn to the Net Revenue Account you will see that we have carried £12,500 to Reserve. Bank interest is lower by £75, due to a lower rate. Interest on investments is higher by £347 owing to the increase in the amount invested shown below in the balance-sheet. The profit on exchange is higher by £401. Increased remittances at a slightly higher rate of exchange account for this. The resulting balance carried to balance-sheet is £110,333 0s. 8d., or £2,259 higher than the previous year.

The special Reserve Accounts remain unchanged.

We now come to the balance-sheet. The sum of £12,500 has been added to the Reserve. Outstanding dividends are up by £65, but the principal items which call for some explanation to you are the increase of £14,487 in the amounts due by the Company. This, however, you will see is set off by the increase of £13,175 in the amount due to the Company. The two figures shown now are the actual amounts due by and to the Company. Hitherto the Meter Deposits and Bad Debts Reserve have been deducted from the amount due by the Company, but on the advice of our Auditors we ceased this and the figures as shown you will, I think, regard as more informative. On the credit side the Capital Expenditure is the same, the Cash at Bankers and in hand is higher by £3,972 and Investments are higher by £10,000, the Stock Exchange value of these on June 30 last being £62,617 5s. 11d. Value of stores is up by £2,163, mainly due to larger stocks of coal, cast-iron mains, and repairing material.

On these figures the Board will propose the declaration of the usual dividend of 4½%, free of income-tax, and I am confident that you will regard it as well earned. This is the first year of Mr. Savage's appointment as Engineer and General Manager, and he and his assistants have done very well indeed for the Company's interests. During the year under review the buildings and plant both on the Works and the District have been kept in a thorough state of repair and efficiency. The new mains laid are in the south of the City, the district of development, where we look for and are obtaining an increased industrial load. The booster we installed over a year ago is doing all that was expected of it in maintaining pressures.

Our relations with the Public Authorities and the other Public Utility Companies have been most amicable throughout.

During the year 170 new public lamps have been fixed, so that we now light over 19,000 public lamps. The quality and purity of the gas has been maintained and no joint test has been called for by the Calcutta Corporation by reason of any deficiency in this respect.

The industrial and domestic consumers are increasing and an Indian canvasser has been appointed and has made a good start. Besides this, we have taken new premises for our showroom, more in the centre of the city, and are now fitting this up, and a lady demonstrator has been appointed, so you will see our salesmanship is alive. We commenced installing "Electrolux" refrigerators to meet a demand and the outlook is promising. However, this is more a matter for review in the current year. With the growth of our industrial load our General Manager made the suggestion that we should benefit by becoming subscribers to the Industrial and Commercial Gas Development movement, and we have accordingly joined the Gas Light and Coke Company's Centre and we look to receive valuable help from this.

I pointed out when reviewing the accounts that the item of Gratuities shown in the Revenue Account was entirely new. We decided last year after long discussion with our late Manager, Mr. Garsed, both before and since his retirement, and with Mr. Savage, to introduce a system of retiring gratuities for our workmen and revise and systematize our existing practice with regard to staff pensions, and these, coupled with a generous re-grading of increments of pay, were put into force during the year. They were well received by all and have worked smoothly. I will add that the entire scheme is non-contributory and its control and administration rests with the Board.

In the earlier part of this year there was an outbreak of smallpox in Calcutta. This was kept in check by extensive vaccination (now finding stronger belief among Indians). None of our European staff were attacked and few of our workmen, none I am glad to say fatally. A few days ago the passing of the Indian Companies Amendment Bill (1936) appeared in the Press. Our solicitors have had this under examination and there is no reason to suppose that we shall be affected.

Votes of Thanks.

The CHAIRMAN then invited questions from the shareholders.

A SHAREHOLDER said that after the excellent report, on which he congratulated the Board, there was really little left to say. He, however, made sundry suggestions as to the form of presentation of the accounts and the rate of dividend, which matters, the CHAIRMAN said, would be borne in mind, adding, he was of opinion that a dividend of 8% free of income-tax for the year would be admitted by all people out in India as a not unreasonable one, having regard to Oriental as compared with European conditions. He could not hold out any hope of an increased dividend being paid by the Directors. The present figure he thought very satisfactory. When improvements took place from time to time, they would devote some part of them to the welfare of their workmen and to reductions in the price of gas. That was the traditional gas policy to which no one could be antagonistic.

There being no more questions from the Shareholders, the

CHAIRMAN then moved: That the report of the Directors and the Statement of Accounts now submitted be received and adopted.

This resolution was seconded by Mr. STANLEY H. JONES, M.Inst.C.E., and carried unanimously.

The CHAIRMAN then moved: That a Final Dividend of 4½% free of income-tax, making 8% free of income-tax for the year ended June 30, 1936, be declared, and that the Warrants for the same be sent by post to the Proprietors on Nov. 19, 1936.

This was seconded by Mr. HUGH H. MACLEOD, and was carried unanimously.

Mr. W. G. BRADSHAW, C.B.E., then moved that Messrs. B. W. ELLIS and B. M. GILL be re-elected to the Board. In doing so, Mr. Bradshaw observed that these gentlemen had served so well and so fruitfully during the past few years that they could not do better than re-elect them.

Mr. S. H. JONES seconded the resolution, which was carried unanimously.

The CHAIRMAN and Mr. B. M. GILL briefly thanked the shareholders for their re-election to a further term of office.

Mr. R. H. W. ELLIS then moved that the Auditors, Messrs. S. W. Savage and F. J. Bradfield, be re-elected at the same remuneration as last year.

This was seconded by Mr. E. GARSED, and carried unanimously.

Mr. BRADFIELD briefly thanked the shareholders on behalf of Mr. Savage and himself.

The CHAIRMAN then moved a vote of thanks to the Staff in London and Calcutta and the workmen for their services to them during the past year. This vote of thanks had been proposed by Mr. Gill last year, but he had somewhat selfishly brought it back into his own province. He felt the greatest enthusiasm in proposing the vote of thanks. Their new General Manager, Mr. Savage, was going ahead with the courage and enthusiasm which they had expected of him. This was typical, too, of the Assistant General Manager, Mr. Gladstone, Mr. Lyle, and the whole staff, and he thought their results were excellent when the conditions under which they had to work in India were considered. The year had been particularly trying for Mr Savage owing to some of the staff being home on leave and others absent through sickness. He then went on to refer to the recent illness of their Secretary, Mr. Rainer. He had been in their service for 48 years, and this was the first time he had been seriously indisposed. Even then he continued to serve the Company by having work sent to his home. During his absence Mr. Hentsch and Miss Barron had taken up the extra work even to the extent of giving up some of their holidays.

Mr. B. M. GILL seconded the vote of thanks with the remark that he was sure that the staff both in London and Calcutta deserved all the thanks they could give them. The vote was passed unanimously.

Mr. RAINER, acknowledging the vote of thanks on behalf of the staff, said he would have much pleasure in conveying to them the thanks of the Directors and shareholders and he was sure they would appreciate it very much. Conditions in Calcutta had been somewhat hectic during the past few months. Regarding the London staff he had to acknowledge with very great thanks the consideration which had been shown him during his recent illness from which he hoped in due course to make a complete recovery. He also acknowledged the able assistance of his colleagues, Miss Barron and Mr. Hentsch. These two—colleagues of his for over twenty years—had taken all the responsibility off his shoulders during his illness and he felt he could not but acknowledge it with great thanks..

Mr. F. J. BRADFIELD, in moving a vote of thanks to the Directors, said that the shareholders were indeed fortunate in having these gentlemen as Directors, who individually and collectively so admirably carried on their Company. As Auditor he was in an excellent position to endorse the shareholders' opinion of the Board. He would not advise the shareholders to make any changes in the Accounts.

Mr. W. PARKER seconded.

The vote of thanks was carried unanimously and the Meeting closed.

Concluded from p. 596

These difficulties may be overcome in large plants by softening the water to a hardness not below four or five degrees in the lime plant and by allowing a settling period of not less than three-and-a-half hours. The excess alkalinity is removed by sulphuric acid dosage, and the water is then passed over a marble filter which serves to remove any suspended matter and to protect the zeolite and the boilers against any accidental overdose of acid. An example of such a plant is that at the Stanton Ironworks, Nottingham.[3]

REFERENCES.

[1] Water Pollution Research Technical Paper No. 1. "Water Softening. The Base Exchange or Zeolite Process."

[2] "Water Softening at Cambridge," by Ernest Suckling and Philip Porteous. From official Circular No. 125 of the British Waterworks Association, 1935.

[3] "Water Softening and Purification Plant at Nottingham."—"The Engineer," Sept. 6, 1935.

"Boiler Feed Water Treatment," by F. J. Matthews. Hutchinson's Scientific and Technical Publications.

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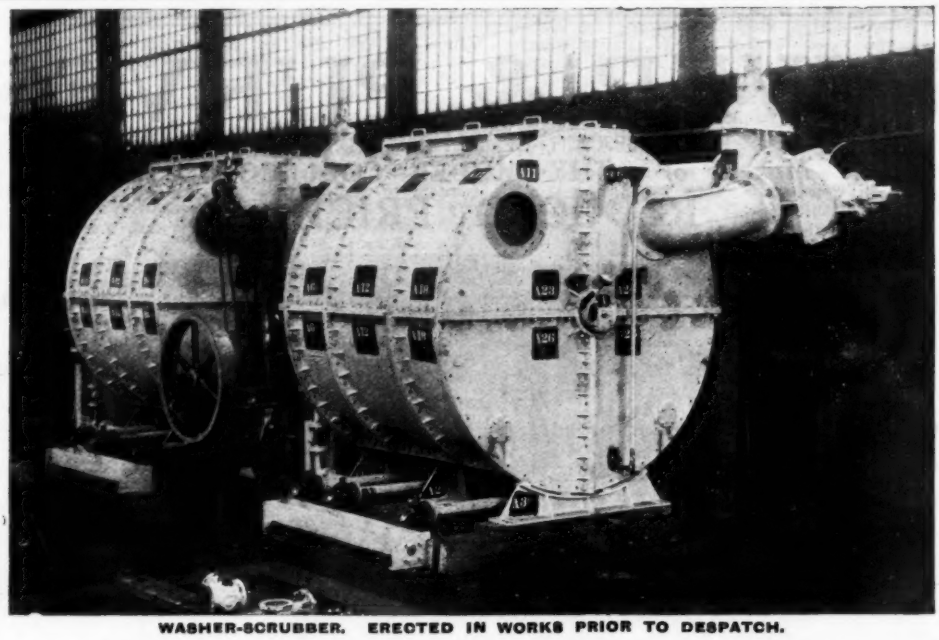

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Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

Business on the Stock Exchange continued very brisk for the greater part of last week, though towards the close buyers became scarce and the tone finished on the dull side. A feature was the quick response to the Government's issue of £100,000,000 2¾% Funding Loan at 98½, which after two days' dealings closed on Friday at par. The loan had little effect on the gilt-edged market as a whole, but a few securities registered fractional falls. Home Rails were exceptionally active, particular attention being paid to L.M.S. and Great Western stocks. The industrial section had a steady investment support, and though iron and steel shares became irregular there were some bright features, notably among the leading textiles. Tin shares maintained their popularity, but rubbers were inclined to weaken.

The feature of the week in the Gas Market was the success of the Gas Light and Coke Company's issue on Wednesday last of £2,000,000 3¾% redeemable preference stock at par which was heavily oversubscribed, and the lists for public applications had to be closed a few minutes after opening. The Company's ordinary units were also well supported, and after the reactions of the past few weeks commenced to harden again, finally closing 3d. higher at 26s. 6d. Another feature was the rise of 7 points in Portsmouth and Gosport consolidated to 179½. Reference has been made on several occasions in the Report to the comparatively low price of this Company's stock, and the yield of £4 11s.% on the current price is still attractive. The Company is making application to the Board of Trade for an order to acquire the Hayling Island Gas Company. It will be noticed that the Colombo Company's two stocks have been reinserted in the List, and the 7% preference rose 3s. 6d. to 24s. 6d.

At the Provincial Exchanges the only variation of note was a gain of 2½ points to 190 in Derby consolidated at Nottingham, while in the Supplementary List the nominal quotation of Yorktown consolidated made a spectacular rise of 22½ points to 155. This Company supplies both gas and electricity, the sales of which have been steadily increasing.

Recent dividend announcements include that of the South Western Gas and Water Corporation, which has declared an interim dividend of 2% on the ordinary shares (unchanged), and the Montevideo Gas and Dry Dock Company, which is paying a dividend of 3% free of tax. With regard to the latter Company, it will be remembered that dividends have been delayed owing to exchange restrictions and payments were promised as funds became available. The present distribution includes 1½% final for 1934 and an interim of 1½% for 1935.

Current Sales of Gas Products

The London Market for Tar Products.

Nov. 23.

Prices of Tar Products in general remain unchanged at the following levels:

Pitch, nominal, at 34s. to 35s. per ton f.o.b.
Creosote, about 5¾d.
Refined tar, 3¾d.
Pure toluole, 2s. 4d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, about 1s. 7d.; and pyridine is firm, with 90/160 about 6s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Nov. 23.

The average prices of gas-works products during the week were: Gas-works tar, 18s. 9d. to 23s. 9d. Pitch—East Coast, 32s. to 34s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 32s. to 34s.* Toluole, naked, North, 1s. 11d. to 2s. Coal tar crude naphtha, in bulk, North, 8d. to 8½d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 5d. Heavy naphtha, North, 1s. 1½d. to 1s. 2½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4¾d. to 5d.; low gravity, 4½d. to 4¾d. Heavy oils, in bulk, North, 5d. to 5¼d. Carbolic acid 60's, 2s. 7d. to 2s. 8d. Naphthalene, £18 to £20. Salts, 90s. to 95s., bags included. Anthracene "A" quality, 3d. to 3½d. per minimum 40% purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Nov.* 21.

Market in this area continues steady but new business is not too plentiful.

Crude gas-works tar.—The actual value is 34s. to 35s. per ton *ex* works in bulk.

Pitch is remarkably quiet considering the time of the year, but meantime prices are unchanged at 30s. to 32s. 6d. per ton f.o.b. Glasgow for export, and 30s. per ton *ex* works in bulk for home trade.

Refined tar is controlled, the prices being 3d. per gallon f.o.r. for export, and 3¾d. per gallon *ex* works in buyers' packages for home trade.

Creosote oil.—There are now one or two large enquiries on the market and quotations are steady as under: Specification oil, 4½d. to 4¾d. per gallon; low gravity, 4¾d. to 5d. per gallon; neutral oil, 4¼d. to 4¾d. per gallon; all *ex* works in bulk.

Cresylic acid.—With little or no supplies available prices are purely nominal as follows: Pale, 97/99%, 2s. 4d. to 2s. 6d. per gallon; dark, 97/99%, 2s. 1d. to 2s. 3d. per gallon; pale, 90/100%, 2s. 9d. to 3s. per gallon; all *ex* works in buyers' packages.

Crude naphtha continues to find a ready outlet at 5½d. to 6d. per gallon *ex* works in bulk, according to quality and district.

Solvent naphtha is comparatively quiet with 90/160 grade at 1s. 4½d. to 1s. 5d. per gallon, and 90/190 heavy naphtha at 11d. to 1s. per gallon.

Motor benzole is easy at 1s. 2½d. to 1s. 3d. per gallon.

Pyridines.—90/160 grade is not lower than 6s. to 6s. 6d. per gallon, and 90/140 grade 7s. to 7s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	8½	to	0	9	per gallon at works
Motor "	1	2	"	1	2½	" " "
90% "	1	3	"	1	3½	" " "
Pure "	1	7	"	1	7½	" " "

Contracts Advertised To-Day

Benzole Plant.
Spenborough Gas Department. [p. 618.]

Coal.
Dewsbury Gas Department. [p. 618.]

Exhausters, Condensers, Washers, Tar Extractors, &c.
Spenborough Gas Department. [p. 618.]

Mechanics' Shop.
Spenborough Gas Department. [p. 618.]

Meter (Station).
Spenborough Gas Department. [p. 618.]

Meters and Meter Repairs.
Batley Gas Department. [p. 618.]

Water Gas Plant Reconstruction.
Newbury Gas Department. [p. 618.]

Gas Undertakings' Results

Churnet Valley.

The Directors of the Churnet Valley Gas Company, in their report and statement of accounts for the year ended Sept. 30, 1936, state that the revenue account shows a profit of £1,036; to this has to be added the unappropriated balance from the previous year, £1,213, making £2,249. Against this has to be charged debenture interest for the year, £276, and bank interest £113, making together £389, leaving for disposal at the present time £1,860. The Directors recommend this sum shall be applied in the following manner—viz., by paying a dividend for the year ended Sept. 30, 1936, at the rate of 2½% per annum (less tax) £381, and by carrying forward to the current year the balance of £1,479. During the year Mr. A. Wrigley was invited and accepted a seat on the Board of Directors.

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Contracts placed with West's Gas Improvement Company, Ltd., during the present year have included carbonizing plant installations for the Gas Undertakings of *Altrincham, *Bilston, *Carlisle, *Dudley, *Worcester, and *Yeadon, in England; *Dumbarton, *Grangemouth, and Kelso, in Scotland; *Ballymena, in Ireland, and *Johannesburg, in South Africa.

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STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Nov. 20.	Rise or Fall on Week	Transactions, Lowest and Highest Prices During the Week.
1,767,439	Stk.	Sept. 7	7⅞	8	Alliance & Dublin Ord. ...	167—172	...	...
374,000	,,	June 22	4	4	Do. 4 p.c. Deb. ...	94—99	...	...
557,655	,,	Aug. 10	7	7	Barnet Ord. 7 p.c.	168—173	+1	171½—172½
300,000	1	Oct. 5	1/9⅔	1/4⅔	Bombay, Ltd.	26/—28/-	...	27/—27/6
179,305	Stk.	Aug. 10	9½	9½	Bournemouth sliding scale ...	220—230	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	168—173	...	...
493,960	,,	,,	6	6	Do. 6 p.c. Pref. ...	148—153	...	...
50,000	,,	June 22	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	125—130	...	127—129½
357,900	,,	Aug. 10	7½	7½	Brighton, &c., 6 p.c. Con. ...	168—173	...	...
649,955	,,	,,	6½	6½	Do. 5 p.c. Con. ...	153—158	...	...
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	145—150	...	147½
855,000	,,	Oct. 5	8	7	British Ord.	156—161	...	160—161
100,000	,,	June 8	7	7	Do. 7 p.c. Pref.	151—156	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	108—113	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...	100
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	110—115	...	...
200,000	,,	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	100—103	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov.'33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	June 22	4½	4½	Do. 4½ p.c. Deb. ...	80—85	...	...
626,860	,,	July 20	6	6	Cardiff Con. Ord.	128—133	...	130½
237,860	,,	June 8	5	5	Do. 5 p.c. Red. Deb.	108—113	...	...
98,936	1	Oct. 19	2/-	2/-	Colombo Ord.	1⅛—1⅛	...	...
24,510	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	23 6—25/6	+3/6	25/6
609,204	1	Oct. 5	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	17/6—19/6	...	...
296,053	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	21/—23/-	...	...
1,775,005	Stk.	Aug. 10	5	5	Commercial Ord.	93—98	...	93—94½
620,000	,,	June 8	3	3	Do. 3 p.c. Deb. ...	84—89	...	86—87
286,314	,,	Aug. 10	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
807,560	,,	Aug. 10	7	7	Croydon sliding scale ...	158—163	...	162—163
644,590	,,	,,	5	5	Do. max. div.	115—120	...	...
620,385	,,	June 22	5	5	Do. 5 p.c. Deb.... ...	125—130	...	126½—128
239,000	,,	Aug. 10	5	5	East Hull Ord. 5 p.c....	108—111	...	...
184,555	,,	Aug. 10	6	6	East Surrey Ord. 5 p.c. ...	128—133	...	...
176,211	,,	June 8	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
250,000	1	Nov. 16	6	4	Gas Consolidation Ord. ...	20/6—22/6*	...	...
250,000	1	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	19/—21/-*	...	...
19,284,128	Stk.	Aug. 10	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	26/—27/-a	+-/3	25/10½—26/9
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.... ...	89—92	...	89½—91½
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	105—108	—½	106—108
8,602,497	,,	May 18	3	3	Do. 3 p.c. Con. Deb. ...	86—89	-1	86½—88½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	117—120	...	117½—117½
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	115—118	...	117—118
700,000	,,	Sept. 7	...	25/5§	Do. 3½ p.c. Red. Deb. ...	102—104	...	104
270,466	,,	Aug. 24	6	6	Harrogate New Cons. ...	128—133	...	...
213,200	,,	Aug. 10	6	6	Hornsey Con. 3½ p.c. ...	133—138	...	...
5,600,000	,,	Nov. 2	12	8	Imperial Continental Cap. ...	153—158	—4	155—161
223,130	,,	July 20	3½	3½	Do. 3½ p.c. Red. Debs.	92—97	...	...
285,242	,	Aug. 24	8½	8½	Lea Bridge 5 p.c. Ord. ...	183—188	...	...
11,751	,,	,,	10	8	Maidstone Gas 5 p.c. Cap. Stk.	190—200	...	...
63,480	,,	June 22	3	3	Do. 3p.c.Prp.Db.Sk.	80—85	...	...
75,000	,,	May 18	110	110	Malta & Mediterranean ...	190—200	...	...
392,000	—	Oct. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—105	...	...
231,978	Stk.	Aug. 24	5	5	M.S. Utility 'C' Cons. ...	110—115	...	105½—106½
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	102—107	...	...
360,075	,,	June 22	4	4	Do. 4 p.c. Deb. ...	104—109	...	...
148,955	,,	,,	5	15	Do. 5 p.c. Deb. ...	122—127	...	...
125,000	—	July 1	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	Stk.	Nov. 16	16	16	Montevideo, Ltd.	74—79*	—3	75—78
225,000	,,	Aug. 10	7½	7½	North Middlesex 6 p.c. Con.	170—175	...	...
396,160	,,	Aug. 10	5	5	Northampton 5 p.c. max. ...	110—115	...	...
300,000	,,	Nov. 2	17	19	Oriental, Ltd....	168—173*	+7	170—171
416,617	,,	June 8	8	8	Plymouth & Stonehouse 5 p.c.	168—173	...	...
504,416	,,	Aug. 10	8½	8½	Portsmouth & Gosport Cons.	177—182	+7	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	113—118	...	...
73,350	,	,,	...	5	Do. 5 p.c. Pref. ...	118—123	...	...
363,470	1	Sept. 21	1/-	1/-	Severn Val. Gas Cor. Ld. Ord.	21/6—23/6	+-/6	...
454,510	1	,,	-/10⅔	-/10⅔	,, ,, 4½ p.c. Cum. Pref.	21/—23/-	...	22/6
133,201	Stk.	Aug. 24	5	8½	Shrewsbury 5 p.c. Ord. ...	145—150	...	...
90,000	10	June 8	13½	14	South African...	4—5	...	...
1,152,635	1	Sept. 7	1/2½	1/2⅔	South East'n Gas Cn. Ld. Ord.	27/—29/-	+-/6	28/—28/4½
845,511	1	,,	-/10⅔	-/10⅔	Do. 4½ p.c. Red. Cum. Pref.	21/—23/-	...	21/9—22/-
200,000	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	20/6—21/6	...	...
150,000	Stk.	Aug. 10	...	3½	Do. 3½ p.c. Red. Deb. ...	100—102	...	101½
6,709,895	,,	Aug. 10	6½	5	South Met. Ord.	116—119	...	116½—118½
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf....	145—150	...	146½—148
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf....	104—107	...	...
1,895,445	,,	June 22	3	3	Do. 3 p.c. Deb. ...	87—90	...	87¼—87¾
1,000,000	,,	July 6	5	5	Do. 5 p.c. Red. Deb.	114—117	...	116
1,543,795	,,	Aug. 10	6	6	South Suburban Ord. 5 p.c....	130—135	...	132½—134
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	122—127	...	124—125½
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	102—107	...	...
888,587	,,	June 8	5	5	Do. 5 p.c. Deb....	123—128	...	124—127
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	102—107	...	...
427,859	1	Nov. 16	1/2⅔	9⅔	S. Western Gas & Water Ord.	21/6—23/6	...	21/9
160,523	1	Oct. 19	-/10½	-/10⅔	Do. 4½% Red. Cum. Pref.	20/6—22/6	...	...
110,000	Stk.	June 22	4	4	Do. 4% Red. Deb. ...	100—105	...	...
647,740	,,	Aug. 10	5½	5	Southampton Ord. 5 p.c. ...	112—117	...	117
121,275	,,	June 8	4	4	Do. 4 p.c. Deb.	100—105	...	...
350,000	,,	Aug. 10	5½	5½	Swansea 5½ p.c. Red. Pref. ...	112—117	...	116
106,000	,,	June 8	6½	6½	Do. 6½ p.c. Red. Deb. ...	98—101	...	...
94,000	,,	,,	§35/-	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...	...
1,076,490	,,	Aug. 10	6⅔	6⅔	Tottenham and District Ord.	152—157	...	...
409,835	,,	,,	5⅔	5⅔	Do. 5½ p.c. Pref....	130—135	...	...
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
371,850	,,	June 8	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
369,774	,,	Aug. 10	7	7	Uxbridge, &c., 5 p.c. ...	165—175	...	165
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	123
1,340,521	,,	Aug. 10	7	7	Wandsworth Consolidated ...	159—164	...	161—163
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	124½—125
500,000	,,	,,	...	...	Do. 4 p.c. Pref. ...	104½—107⅞	...	107—107⅞
1,317,964	,,	June 8	5	5	Do. 5 p.c. Deb. ...	127—132	...	130—131
338,300	,,	,,	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
499,735	,,	Aug. 10	7¼	7	Watford and St. Albans Ord.	157—162	...	158
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
200,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	131—136	...	...
200,000	,,	June 22	4	4	Do. 4 p.c. Red. Deb.	100—105	...	...
100,000	,,	,,	...	3½	Do. 3½ p.c. Red. Deb.	99—102	...	...
158,400	,,	Aug. 24	6b	5½	Winchester W. & G. 5 p.c. Con.	120—125	...	...

a.—The quotation is per £1 of Stock. b.—Paid £3, including 10s. on account of back dividends. * Ex div. † Paid free of income-tax. ‡ For year. § Actual.

Stock and Share List continued overleaf.

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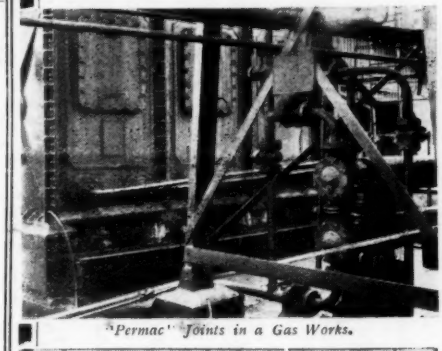

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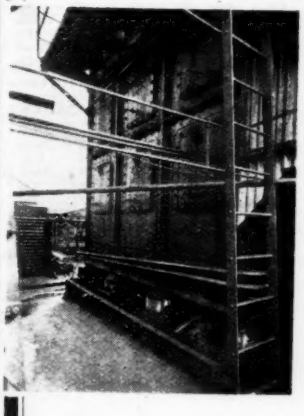

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STOCK AND SHARE LIST—Cont.

Stocks Officially Quoted on Provincial Exchanges

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Nov. 20.	Rise or Fall on Week.	Transactions, Lowest and Highest During the Week.
BRISTOL EXCHANGE.								
347,756	Stk.	July 20	6	5	Bath Cons.	122½—124½	...	...
1,667,250	,,	July 6	5	5	Bristol, 5 p.c. max. ...	120—122	...	...
120,420	,,	June 8	4	4	Do. 1st 4 p.c. Deb. ...	103—105	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	103—105	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	124—127	...	...
274,000	,,	Aug. 10	5	5	Newport (Mon.) 5 p.c. max....	110—114	...	...
13,200	12	Sept. 7	8½	7	Pontyp'l Gas & W. 10 p.c. 'A.'	13½—14½	...	...
13,600	10	,,	6	5	Do. 7 p.c. B.'	12—12½	...	...
40,000	10	,,	6	5	Do. 7 p.c. 'C.'	12—12½	...	...
140,778	Stk.	Aug. 10	5	5	Weston-super-Mare Cons. ...	112—114	...	...
64,338	,,	June 22	4	4	Do. 4 p.c. Deb.	100—102	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	163—166	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Aug. 10	6½	5	Chester 5 p.c. Ord.	107—112	...	...
92,500	,,	June 8	4a	4	Do. 4 p.c. Pref.	98—102	...	...
32,540	,,	,,	3	3½	Do. 3½ p.c. Deb. ...	90—95	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	99—103	...	...
2,167,418	,,	Aug. 24	6	6	Liverpool 5 p.c. Ord. ...	135—137	...	...
245,500	,,	June 22	5	5	Do. 5 p.c. Red. Pref ...	103—108	...	...
306,083	,,	July 6	4	4	Do. 4 p.c. Deb. ...	104—106	...	...
106,280	,,	July 20	10	10	Preston 'A' 10 p.c. ...	198—208	...	...
188,219	,,	,,	7	7	Do. 'B' 7 p.c.	137—147	...	...
NEWCASTLE EXCHANGE.								
122,877	Stk.	Aug. 10	8	8	Blyth 5 p.c. Ord.	153—155	...	...
732,000	,,	Aug. 10	5	5	Hartlepool G. & W. Co. & New	124—126	...	...
2,061,315	,,	Aug. 10	5½	5	Newcastle & Gateshead Con.	28·—28/6a	...	...
682,856	,,	,, ½	4	4	Do. 4 p.c. Pref. ...	103—105	...	...
776,706	,,	June 22	3½	3½	Do. 3½ p.c. Deb. ...	100—102	+1	...
277,285	,,	May 4	5	5	Do. 5 p.c. Deb. '43...	108—109	...	...
209,820	,,	Aug. 10	8½	8½	South Shields Con.	172—174	...	...
299,542	,,	Aug. 10	6	6	Sunderland 6 p.c. max. ...	132—134	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Aug. 10	10	7	Derby Con.	185—195	+2½	...
35,000	,,	June 22	4	4	Do. 4 p.c. Deb.	100—105	...	...
84,750	,,	Feb. 17	5	12	Long Eaton 'A' Ord. ...	...	...	...
50,000	,,	,,	4	10	Do. 'B' Ord. ...	...	...	...
20,000	10	June 8	5	5	Do. 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	117—122	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Aug. 10	10	10	Great Grimsby 'A' Ord. ...	220—230	...	...
6,500	,,	,,	10	10	Do. B' Ord. ...	220—230	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—215	...	...
1,806,339	,,	Aug. 24	6	6	Sheffield Cons.	146—148	...	...
95,000	,,	July 6	4	4	Do. 4 p.c. Deb.	102—105	...	...

a The quotation is per £1 of Stock.

Supplementary List of Stocks and Shares not Officially Quoted

202,152	Stk.	Nov. 2	5	25/-a	Ascot Ord.	118—123	...	...
128,182	,,	July 6	...	5	Do. 5 p.c. Pref.	15—120	...	...
238,631	1	Nov. 16	5	5	Assd. Gas and Water Ord....	20/6—22/6*	—/6	...
323,681	1	,,	4½	4½	Do. 4½ p.c. Cum. Pref. ...	21/—23/-*	—/6	...
150,000	Stk.	Sept. 21	...	3½	Do. 3½ p.c. Red. Deb. ...	98—101	...	...
17,000	,,	Aug. 24	8	8	Bognor Orig. Ord. 'A'	175—185	...	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	175—185	...	...
87,160	,,	,,	7	7	Do. New 7 p.c. max. ...	145—150	...	...
97,440	,,	Aug. 10	10	10	Cam.Univ. & Town 10 p.c.max.	205—215	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	155—160	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	108—113	...	...
65,000	,,	Aug. 10	8½	7½	Eastbourne 'A' 5 p.c. ...	175—180	...	...
198,000	,,	,,	7	6	Do. 'B' 3½ p.c.	142—147	...	...
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	118—123	...	...
130,000	,,	June 22	5	5	Do. 5 p.c. Deb.	124—129	...	...
24,000	30	Aug. 10	8½	8½	Great Yarmouth 8½ p.c. max.	51—56	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.... ...	42—45	...	...
51,160	Stk.	June 8	5½	5½	Do. 5½ p.c. Deb....	123—128	...	...
182,600	,,	Sept. 7	8	8	Guildford Cons.	182—192	...	192
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	114—119	...	...
68,250	,,	June 8	5	5	Do. 5 p.c. Deb.	120—125	...	...
156,600	,,	Aug. 24	7½	7½	Hampton Court Cons. ...	173—178	...	...
107,960	10	Oct. 5	5½	4	Mid Kent Ord.	10—11	...	...
230,940	Stk.	Aug. 10	10	10	Oxford & District Ord. ...	210—220	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	118—123	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pre ...	113—118	...	...
126,193	,,	Nov. 16	7½	7½	Peterborough Ord.	162—172*	+2	...
64,990	,,	Sept. 7	6½	7½	Redditch Ord.	133—143	...	...
166,850	,,	Aug. 10	9	8	Romford Ord.	168—178	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Sept. 21	5	5	Do. 5 p.c. Deb.	120—125	...	...
10,950	,,	Aug. 24	8	8	Ryde Ord.	165—170	...	...
136,191	,,	Aug. 10	7	5	Scarborough Ord.	126—136	...	...
27,825	,,	Aug. 24	8	8	Shanklin & Ventnor Cons. ...	180—190	...	...
40,643	,,	Sept. 21	7	7	Slough Ord.	156—161	...	...
221,000	,,	June 22	5	5	Do. 5 p.c. Deb.	116—121	...	...
28,872	1	Nov. 2	5½	5½	S. Midland Gas Cpn.Ltd. Ord.	22/—24/-	...	...
28,866	1	Sept. 7	4½	4½	Do. 4½ p.c. Red. Cum Pref.	22/—24/-	...	...
137,730	Stk.	Aug. 10	7	7	Southgate & Dist. 7 p.c. max.	151—156	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	120—125	...	...
117,228	,,	Aug. 10	6	5	Swindon Cons.	110—115	...	...
60,425	,,	June 22	5	5	Do. 5 p.c. Deb.	120—125	...	...
64,380	,,	June 8	5	5	Torquay and Paignton 5 p.c. Pf.	117—122	...	...
750,000	1	Oct. 5	5·52d a	4	Utd. Kingdom Gas Cpn. Ord.	21/6—22/6	...	21/9—22/3
468,574	1	,,	2½	2½	Do. 4½ p.c. Prefd. Ord....	20/—22/-	...	...
935,902	1	Nov. 16	4½	4½	Do. 4½ p.c. Cum. Pref. ...	22/6—23/6*	...	22/7½—23/3
600,000	Stk.	Sept. 21	3½	3½	Do. 3½ p.c. Red. Deb. ..	99—102	...	...
130,000	,,	Aug. 10	8	5	Wakefield Ord.	140—145	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	105—110	...	...
82,000	,,	July 20	6	6	Weymouth Ord.	105—110	...	...
98,384	,,	Aug. 10	6	6	Wolverhampton 6 p.c. Pref.	127—132	...	...
160,000	,,	June 8	5½	5½	Do. 5½ p.c. Rd. Db	107—112	...	...
370,000	,,	July 20	6	4	York Cons.	111—116	...	...
90,000	,,	June 22	5	5	Do. 5 p.c. Red. Deb. ...	107—112	...	...
133,640	,,	July 20	6½	6½	Yorktown (Cam.) 5 p.c. Cons.	150—160	+22½	...
120,000	,,	,,	5	5	Do. 5 p.c. Pref.	123—128	+5	...
35,000	,,	June 22	5½	5½	Do. 5½ p.c. Deb.... ...	130—135	...	...

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